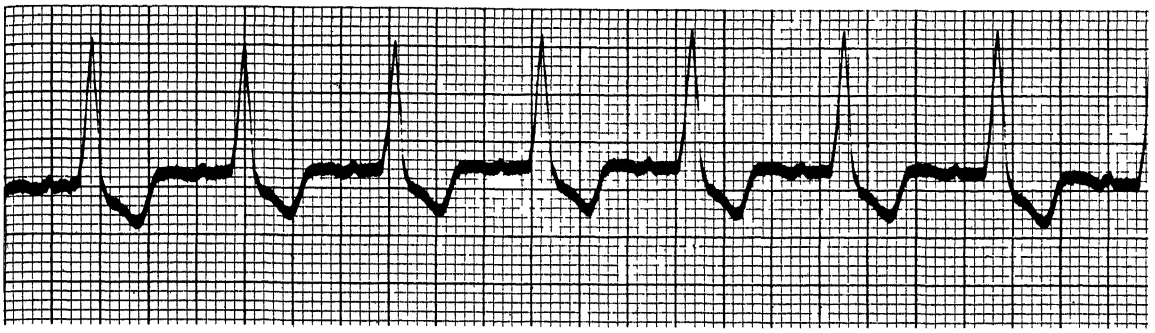

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FIELD STUDIES IN HEART DISEASE

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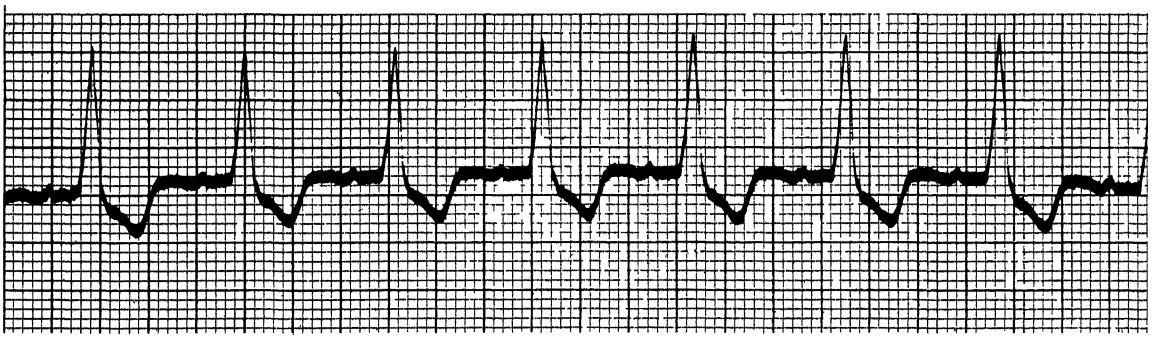

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A Review of Concepts, Study Designs
and Findings for the Purpose of
Developing a Field Study
of Heart Disease Among
Ohio Farmers

Saad Z. Nagi and Wade H. Andrews

INTRODUCTION

Researchers from several disciplines are engaged in continuous attempts to unravel the complexity of factors involved in the etiology of, and the adjustment to, heart impairments. Investigations in this area can be carried out on two different, but complementary levels. The first level is that of laboratory or clinical studies in which the focus is upon individual cases, and the second is that of field studies that utilize general populations. The need for approaching the problem of heart disease on both levels is well expressed in the following statements of a noted cardiologist.

> Laboratory experiments on animals and clinical laboratory studies on man have been done fruitfully and should be continued, but a much neglected field, the surface of which has barely been scratched during the last five or ten years is that of the relationship of the ways of life to heart disease which we can come to call epidemiological cardio-vascular research.
>
> My own experience to date has been that important clues can come from individual intelligent patients as well as from mass studies.[1]

This report has been prepared for the purpose of reviewing the definitions, designs and findings of the important field studies of heart disease. Some relevant findings of clinical research are also included in the discussion. This review is intended to provide background data needed in designing a field study of heart disease among farm people in Ohio.[2]

The subject matter of this report is presented under four headings: (1) Definition and classification of heart disease. (2) Sources of data. In this section data are grouped into mortality, morbidity and special survey and research data. Under the third type of data, the objectives and study plans of several important studies are reviewed.

1 P. D White, "The Cardiologist Enlists the Epidemiologist" *Am Jour Pub Health*, 47, 4 1-3, 1957

2 The study is conducted by the Ohio Agricultural Experiment Station Its development is made possible by a grant from the Central Ohio Heart Association, Columbus, Ohio.

For those interested in developing studies in this area, it is recommended to see E. A Suchman, *The Study of Heart Disease Among Farm Populations*, Cornell University, July 1958, and Commission on Chronic Illness, *Chronic Illness in a Large City — The Baltimore Study*, Harvard University Press, 1957.

(3) Design of field studies. This part includes a general discussion of the objectives, durations, populations, sampling methods and techniques of detecting heart disease, that can be used in field studies. (4) Review of findings. These are reported in three categories: (a) Those related to heart disease as a dependent variable, (b) those related to heart disease as an independent variable, and (c) other miscellaneous findings. An extensive bibliography is included in the Appendixes of the report.

Individual acknowledgement for the assistance extended during the preparation of this report is felt to be an endless task. The authors, however, would like to express their deep appreciation to all who helped by suggestions, constructive criticisms and/or sending material and publications.

Special acknowledgement is due to Dr. George Morrice, Jr., M.D., president of the Central Ohio Heart Association; Professor Raymond F. Sletto, Ph.D., chairman of the Department of Sociology and Anthropology at the Ohio State University; and Dr. Jack Elinson, Ph.D., Associate Professor of Administrative Medicine at the School of Public Health and Administrative Medicine, Columbia University, for their critical review of the manuscript.

THE DEFINITION AND CLASSIFICATION OF HEART DISEASE

The functional importance of the heart, its bearing upon and response to ills of other parts of the human organism, partially complicates the problem of definitions. Criteria of delineation are necessary to distinguish between diseases that involve the heart and others without heart involvement. A second source of complexity stems from the asymptomatic nature of some types of heart disease, especially in the early stages. A third complexity lies in the definition of "disease" itself. The dichotomy of health and disease actually represent two poles on a continuum rather than two isolated and separate conditions. Special diagnostic criteria are developed for each disease to define certain points on this continuum that differentiate between the normal and the diseased. These points of differentiation are often changed by the advancement of knowledge about the nature of the disease and by increases in the sensitivity of diagnostic techniques.

The various types of heart disease can be generally described as being either congenital or non-congenital. Congenital heart disease refers to the malformations with which the child is born, while the non-congenital group includes diseases that develop after birth. Both the congenital and the non-congenital categories include diseases which are caused by infectious agents and others that result from noninfectious etiological factors. In other words, diseases of the heart can be classified into four main categories: (1) congenital-infectious

diseases, such as congenital syphilitic heart disease; (2) congenital-noninfectious diseases, such as abnormalities of the heart present at birth but not caused by an infectious agent during the period of pregnancy; (3) noncongenital-infectious diseases, such as rheumatic heart disease; and (4) noncongenital-noninfectious diseases, such as arteriosclerotic and hypertensive diseases of the heart. This last category includes the most important causes of death by heart disease.

For detailed classification of heart disease, two main methods have been used by field investigators. The first of these methods, the International Statistical Classification, was developed under the auspices of the World Health Organization. The other method, the Nomenclature and Criteria of Diagnosis, was developed by a special committee from the New York Heart Association. The following paragraphs include a brief description of these two methods of classification.

The International Statistical Classification

Usually this method of classification is referred to as the "ISC."[3] It was developed by the World Health Organization for the purpose of standardizing the rules for coding morbidity and mortality statistics among member nations. The scheme of classification used here represents a series of necessary compromises between classifications based upon etiology, anatomical site, age, and circumstance of on-set as well as the quality of information available from medical reports.[4] The ISC utilizes a numerical system of categories using a three and four digit code throughout the list.

The practical advantage of the ISC lies in the utilization of one cause of death or illness; yet the selection of the cause to be reported presents a complicated problem. In respect to mortality causes, it was agreed upon to report the underlying cause of death. This cause is defined as: "The disease or injury which initiated the train of morbid events leading directly to death; . . . symptoms or modes of dying . . . are not considered to be causes for statistical purposes".[5] In regard to morbidity, the dynamic and indefinite character of illness experiences made the application of the ISC to morbidity causes a harder task. The application of the ISC method to morbidity data, however, varies to suit the particular morbidity experience under investigation and the purpose for which the data are obtained.[6] The British Medical Research Council and the U. S. Public Health Service recommend different methods in recording morbidity causes. The

3 The World Health Organization, *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death,* Vols I and II The latest revision in use is that adopted in 1948

4 *Ibid*, Vol 1, 1948 p xiii

5 *Ibid.*, p 345

6 *Ibid*, pp xxxv xxxvi

following quotation from the ISC explains the basic differences between the two methods of selection:

> According to the British M.R.C. the condition to be classified is 'the final diagnosis of the principle disease or injury on account of which the patient sought treatment The main interest here is centered on the condition which brought the individual under medical care. Some consideration is given to the classification of principle accessory chronic disease.'
>
> On the other hand, 'the Manual for Coding Causes of Illness issued by the U. S. Public Health Service . . . points out that the interest in morbidity statistics often centers on the frequency of specific diseases, whether they are the major factor in the illness or are complications, sequellae or concurrent conditions. Thus, for many studies tabulation of all these diagnoses is important.'[7]

The U. S. Department of Health as well as those departments of the individual states utilize the ISC in their morbidity and mortality statistics reports. Their classification for the important "diseases of the heart" consist of diseases with codes numbered from 410 to 443,[8] grouped under four categories: (a) chronic rheumatic heart disease, numbered 410 to 416, (b) arteriosclerotic and degenerative heart disease, 420 to 422, (c) hypertensive heart disease 440 to 443, and (d) other diseases of the heart, 430 to 434.[9] Under each of these categories there are several types of heart diseases of which some are further classified into sub-categories by a fourth digit in the code.[10] The ISC method has been also utilized in several survey and research works in the area of heart disease.[11]

The ISC was developed to serve statistical rather than diagnostic purposes, its use is advantageous to those interested in general classifications. Although there have been some attempts to improve the accuracy of the ISC coding and reporting methods, it is still rather inadequate for research purposes that require careful diagnostic categories.[12]

Nomenclature and Criteria for Diagnosis of Diseases of the Heart

Many inadequacies in the ISC method of classification may be overcome by using a more detailed nomenclature for diseases of the heart. The most widely used nomenclature of this kind, in the area

7 *Ibid* p xxxvi

8 See Appendix I

9 The numbers as shown are not given in consecutive order

10 The International Statistical Classification, *op cit*, pp 132-139

11 For example see J N Morris J A Heady, P A Raffle, C G Roberts and J W Parks, "Coronary Heart Disease and Physical Activity of Work' *Lancet* 265 1053-1057, and Commission on Chronic Illness, *Chronic Illness in a Large City — The Baltimore Study,* The Commonwealth Fund, 1957

12 L Weiner, M T Bellows, G H McAvery and E V Cohen, ' Use of Multiple Causes in the Classification of Deaths from Cardiovascular-Renal Disease " *American Journal Public Health* 45 492 501

13 The Criteria Committee of the New York Heart Association, *Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels,* the New York Heart Association, Inc , 5th ed , 1955

of heart disease, is that developed by the Criteria Committee of the New York Heart Association.[13] It has undergone several revisions since it was first issued in 1928.

In contrast with the ISC, the New York Heart Association nomenclature was developed primarily to serve diagnostic rather than statistical purposes. Such a nomenclature differs from the ISC in its specific and detailed definitions, classifications and coding procedures. According to this nomenclature, the definition of each case is based upon its etiological, anatomical, physiological, functional and therapeutic aspects. The New York nomenclature includes a detailed classification of these five aspects of diseases, with defining criteria and a code number for each item.

> A complete diagnosis should include one or more titles from each of the main headings of this nomenclature. There should be a statement as to the etiology of the disease. If structural changes are discovered, they should be named or there should be a statement that there is no structural disease. There should be a statement indicating the cardiac mechanism and any disturbance of cardiac physiology which may have arisen, particularly a diagnosis of the cardiac functional capacity, and a statement of the patient's therapeutic classification completes the list. Thus, a comprehensive diagnosis will demand a careful consideration of every aspect of the case . . . [14]

The methods of classification discussed here are by no means contradictory. Their differences lie mainly in their coding systems and in the level of their specificity and completeness.

Implications of Definitions and Classifications

Three main problems face investigators in defining and classifying heart disease to suit the objectives and scope of their studies. First, the investigator has to decide upon the level of generality-specificity in conceptualization at which he can attain maximum reliable information. For example, treating arteriosclerotic and coronary heart disease (420) categorically, although revealing, may obscure the intracategorical differences between arteriosclerotic heart disease (420-0), heart disease involving the coronary arteries (420-1), and angina pectoris (420-2).[15] In fact, by grouping (420-1) and (420-2) together, Morris and associates found the rate of their occurrence to be higher among drivers than conductors of London Transport Workers.[16] A more specific analysis, in which these two types of heart disease were treated individually, showed a higher rate of prevalence for the first type among drivers, while angina pectoris was found to be more prevalent among conductors. This indicates that, while broader conceptualization may be more suitable for statistical tabulations and

14 *Ibid* p 3
15 Figures refer to ISC code numbers, see Appendix I
16 J N Morris, et al, *op cit*

reports, specific classification is required for comprehensive research — especially that dealing with etiology of the different diseases of the heart. The need for delineation and classification of diseases of the heart for adjustment studies and rehabilitation practices can also be demonstrated. For example, adjustment to a congenital heart impairment may differ in both process and results from adjustment to other types of heart disease. More important in the study of rehabilitation and adjustment, however, is the evaluation of the patients' functional and therapeutic conditions.[17]

The second problem that faces the investigator is that of delineating a scope for the study, or in other words, deciding upon the types of heart disease to be studied. Adjustment studies are needed for almost every type of heart disease. Epidemiological and other etiological studies are needed more for diseases of unknown etiology. The following statements illustrate this point:

> Of the epidemiology of hypertensive or arteriosclerotic cardiovascular disease, almost nothing is known, although these two account for the great bulk of deaths from cardiovascular disease ... Clearly, what is required is the epidemiological study of these diseases based on populations of normal composition, including both the sick and the well as they are found in the community.[18]

A third problem is that of the methods to be used in identifying the different types of heart disease. This problem will be given special attention in a later part of the discussion.[19]

TYPES AND SOURCES OF DATA

Three types of data are being used in the study of heart disease: (a) mortality data, (b) general morbidity data, and (c) special survey and research data. The third type of data is distinguished from the second on the basis of the purpose for which the data are collected. Secondary sources are available for each of these three types of data, such as: public health statistical reports, morbidity survey reports and the published results of special heart disease studies. Although promising information has been already accumulated, there is a definite need for new studies yielding comprehensive first hand data. This section of the report includes a further discussion of the above mentioned types of data.

Mortality Data

Mortality statistics are the most standardized of all data, both within the United States and among member nations of the World

17 The Criteria Committee of the New York Heart Association, *op cit*, pp 80 82

18 T R Dawber, G F Meadors and F E Moore 'Epidemiological Approaches to Heart Disease The Framingham Study", *Am Jour Pub Health*, 41, 3 279 286

19 See page 47 of this report

Health Organization. Statistical data about causes of death in the United States are available for the nation and for the individual states. Several periodical reports about causes of death are issued by the National Office of Vital Statistics (NOVS) and by the divisions of vital statistics of the different states. These reports are based upon information provided by death certificates. The underlying causes of death are recorded and coded according to the ISC system.

In utilizing mortality statistics in analytical studies, the investigator should be aware of several limitations characteristic of such data. These limitations result from a certain degree of inaccuracy in the diagnosis and reporting of causes of death. Moriyama states that, "It was the impression of that office (NOVS) that an increasing number of deaths from coronary disease were being reported by coroners and medical examiners where the deceased had not received medical attention or the cause of death was not known."[20] Lew pointed out other sources of inaccuracy in recording some types of heart disease, claiming that accuracy is lacking more in rural areas due to inferior facilities and training in cardiology among physicians.[21] In assessing the value of occupational statements in mortality data, Buechley and his associates through the analysis of occupational histories of a sample of deceased persons, distinguished among three occupational types.[22] These types are: the usual occupation, the last occupation, and the exposure occupation.[23] Although exposure occupations are the ones most expected to affect the health condition of the individual, these investigators found that the last occupation of the deceased was the most often reported on death certificates. They also pointed out that there is a tendency to move occupations upward rather than downward, and that the greatest error in reporting of occupations is for farmers and farm laborers.

Other limitations to the use of mortality data in detailed investigations were adequately described as follows:

> But death certificates give no clue to prevalence of non-fatal disease at any particular time or to the age at which the disease was first manifest. They give no information on the duration of illness or the income levels and living conditions of those who died. Neither do they take into consideration illness other than the immediate and underlying causes of death.[24]

Mortality statistics, however, are valuable sources of classified information about deaths "by cause, for various age, sex, and racial

20 Quoted in "Some Implications of Mortality Statistics Relating to Coronary Artery Disease", by E A Lew, *Jour of Chronic Diseases,* Vol 6 No 3, p 196

21 *Ibid.,* pp 192-209

22 Buechley, J E Dunn, Jr , G Linden and L Breslow, "Death Certificate Statement of Occupation Its Usefulness in Comparing Mortalities", *Public Health Reports,* Vol 71, 1105-1111

23 An exposure occupation is that in which the person has spent five years or more An individual may have more than one exposure occupation

24 Commission on Chronic Illness, *op cit* , p 8

groups, and for various parts of the country."[25] They can be useful in studying the patterns of distribution of different causes of death through time and space. Ecological studies of mortality by the different types of heart disease provide an important source of hypotheses. Such studies require considerable attention in planning and selecting the variables to be studied.

Morbidity Data

Methodological problems and costly operations have always obstructed the regular collection of general national or state morbidity statistics. Aside from the National Health Survey of 1935-36, morbidity surveys have been of a more limited scope.[26] The household interview was the most widely accepted method of collecting data in the several surveys that have been made.[27] In spite of the methodological improvements and the added care in administration, the household interview technique has not demonstrated a consistently adequate degree of utility for epidemiological purposes.[28] In the more recent morbidity studies considerable attention has been given to the investigation of the methodological problems involved in the collection of reliable data.[29]

Special Survey and Research Data

This type of data is collected through surveys and research designed particularly for, or with special emphasis upon, studying diseases of the heart. Sources for these data are still limited. However, a number of promising studies have been undertaken during the last decade. The following is a brief review of the objectives and research design of a selected number of such studies:

The Hunterdon County Study of Chronic Illness

This is one of two studies proposed by the Commission on Chronic Illness to investigate this kind of disease in essentially rural

25 *Ibid.*, p. 8.

26 "Illness and Medical Care Among 2,500,000 Persons in 63 Cities, with Social Reference to Socio-Economic Factors", Washington, D. C. Government Printing Office, 1945.

27 For example see K. S. Trantham and J. L. Lehmann, S. D. Collins, "Sickness Experience in Selected Areas of the United States." *Public Health Monograph* No. 25; S. D. Collins, J. L. Lehmann and K. S. Trantham, "Major Causes of Illness and of Death in Six Age Groups," *Public Health Monograph* No. 30, D. L. Gibson, C. P. Loomis, P. A. Miller, E. A. Schuler, J F. Thaden, C. R. Hoffer, "Health Needs and Health Care in Michigan", Michigan State College, Agricultural Experiment Station; Special Bulletin No. 365, June, 1950.

28 D. E. Kreuger, "Measurement of Prevalence of Chronic Disease by Household Interviews and Clinical Evaluations." *Jour. of Public Health*, 47, 8: 953-960.

29 For example see: Commission on Chronic Illness, *op cit.*, and L. Breslow, H. W. Mooney, "The California Morbidity Survey· A Progress Report," *California Med.* 84, 2: 95-97.

and urban populations.[30] Hunterdon County, New Jersey and Baltimore, Maryland, were the selected sites for these two studies respectively. Except for certain unavoidable differences in operating details, these two studies were identical in objectives and similar in design. They were both launched with the following objectives:[31]

1. To obtain estimates of:
   a. Prevalence of chronic disease by diagnosis measured at a point in time by a complete diagnostic examination, and variations in prevalence associated with age, sex, color, economic level, and other significant social and economic factors.
   b. Prevalence of illness and disability resulting from chronic disease by diagnosis, degree and duration of disability.
   c. Prevalence of nonmanifest or asymptomatic chronic disease, obtained through detection procedures including the multiple screening technique.
   d. The rehabilitative potential of chronically ill and disabled individuals.
   e. The needs for facilities and services for treatment and rehabilitation of the chronically ill in terms of hospital care, home care, nursing home care, and domiciliary care.
2. To provide for the testing and evaluation of:
   a. New and more thorough methods of studying the magnitude and nature of the chronic disease problem.
   b. The multiple screening process.

Investigators in these two studies have given considerable attention, as indicated in the above statement of objectives, to methodological problems as well as to morbidity estimates. The Hunterdon County study was planned and carried out in the period 1951-1955, in the following five phases:[32]

First — A self-administered questionnaire for each member of every family was delivered to each household. This step covered the total population of the county, estimated at about 13,000 families including more than 43,000 members. The rate of return of these questionnaires, which was on a voluntary basis, was 56 per cent.

30 The Hunterdon County Study was conducted by the Commission on Chronic Illness in cooperation with. The Hunterdon Medical Center, the New Jersey State Department of Health and the National Opinion Research Center of the University of Chicago.

The Commission on Chronic Illness is an independent national agency founded by: The American Hospital Association, the American Medical Association, the American Public Health Association and the American Public Welfare Association. It was supported by grants from the United States Public Health Service and the Commonwealth Fund. The Commission was dissolved in 1957.

31 Commission on Chronic Illness, *op. cit.*, pp. 21-22.

32 R. E. Trussell, J. Elinson and M L. Levin, "Comparisons of Various Methods of Estimating the Prevalence of Chronic Disease in a Community — The Hunterdon County Study." *Amer. Jour. of Public Health*, 46: 173-182, 1956.

Second — Health histories were secured from 4,246 families (13,113 individuals) through household interviews. Each interview covered the health history of all family members within the 12 months preceding the interview. These families constituted a random sample selected on an area probability basis from the resident families. The 4,246 completed interviews represent 91 per cent of all families sought, and were used as a base for the following three steps:

Third — Diagnostic information in regard to 1,569 patients reporting chronic illness was sought, through confidential communication, from 329 attending physicians named by those patients. Half of the physicians were told what had been reported in the interview and the other half were not. Eighty-six per cent of the physicians cooperated by filling out and returning 70 per cent of the mailed forms. Data obtained through this phase were used in comparing information from physicians attending a rural population, with that secured through self-administered questionnaires, household interviews, multiple screening and medical examination.

Fourth — Several stratified sub-samples were drawn. These subsamples included about 1,000 individuals representing the various kinds of illness and disability as well as others with no reported illness. Individuals included in these samples were given complete medical, nursing and social evaluation. These evaluations were completed for 846 individuals representing a weighted 72 per cent of individuals sought.

Fifth — In this final phase 7,953 individuals over the age of 16, who were presumably well, were asked to participate in a multiple screening test. Tests were completed for 2,679 individuals representing 34 per cent of those requested to participate.

Three reports have been published describing the methodology and some of the findings.[33] An inclusive report about this study is in press.[34]

The Baltimore Study of Chronic Illness

As was mentioned above, the city of Baltimore, Maryland, was the selected site for the study of chronic disease in an urban setting, as proposed by the Commission on Chronic Illness. The study was conducted by the Commission in cooperation with the Johns Hopkins University and Hospital and the United States Bureau of the Census.

33 See J Elinson and R E Trussell, Some Factors Relating to Degree of Correspondence for Diagnostic Information Obtained by Household Interviews and Clinical Examinations", *Amer Jour of Pub Health,* 47 311-321, R E Trussell and J Elinson, "Measuring Needs for Medical and Related Services" *Administrative Medicine Transactions of the Fourth Conference,* Josiah Macy Jr Foundation, 9-66, 1955, and R E Trussell and J Elinson, "Comparisons of Various Methods of Estimating the Prevalence of Chronic Disease in a Community — the Hunterdon County Study", *Amer Jour of Public Health,* 46 173 182

34 R E Trussell and J Elinson, *Chronic Illness in a Rural Area,* Vol III of, *Chronic Illness in the United States* Commission on Chronic Illness, Harvard University Press

It was carried out between 1952 and 1956. Results are presented in an inclusive report published in 1957.[35]

Although the objectives of this study are identical to those of the Hunterdon County study, the plans of the two studies were somewhat different. Some of the differences in the two plans resulted from the experience gained during the Hunterdon study which preceded that of Baltimore by almost a year. The first and third methodological steps used in the Hunterdon study were dropped in the Baltimore study. In other words, self-administered questionnaires were not used and diagnostic information not sought from attending physicians were not classified or tabulated independently. The study proceeded according to the following steps:

> Step. 1 An interview by trained interviewers to obtain information about illness and disability in approximately 4,000 households, including about 12,000 people and representing a random sample of the population of the city.
>
> Step 2. A "clinical evaluation" of a sample of approximately 1,000 persons. This evaluation consisted of a review of existing medical information obtained from hospitals and private physicians; a complete diagnostic examination . . . at a special clinic established for the purpose at the Johns Hopkins Hospital; and, for a special group, an evaluation of social, nursing and rehabilitation needs by a team composed of a physician, a nurse, a social worker, and a vocational counsellor.
>
> Step 3. The administration of a series of simple screening tests to all members of the 4,000 households who were not included in step two and who were over 16 years of age.
>
> Step 4. A demonstration of rehabilitation for those persons identified in step two as having a vocational rehabilitation potential. The Division of Vocational Rehabilitation of the Maryland State Department of Education assumed the responsibility for this step in order to give a practical test to the process of estimating rehabilitation potential.[36]

The time interval between the interview step and the rest of the steps was considerably shorter in this study than in the Hunterdon County study.[37] Both studies utilized the "International Statistical Classification" (ISC) method of coding disease. As has been shown in the plans of the two studies, various techniques were used in the detection of disease. These techniques ranged from self-administered questionnaires to complete diagnostic evaluations.

35 *Ibid.*, pp 27-28
36 *Ibid.* pp 27-28
37 *Ibid.* p 24

The Framingham Study

This is an important epidemiological investigation of diseases of the heart, with special emphasis upon arteriosclerotic and hypertensive cardiovascular disease. The study initiated during the period 1948-1950 by the National Heart Institute, is planned to continue for 20 years.[38] It is being carried out in Framingham, Massachusetts, a city of fewer than 30,000 population and lying 21 miles west of Boston. The general objectives of this study can be summarized as follows:[39]

1. To study the environmental and personal factors which are associated with cardiovascular diseases, with special emphasis upon arteriosclerotic and hypertensive diseases of the heart.
2. To study the efficiency of various diagnostic procedures in detecting and/or predicting the subsequent development of heart diseases.
3. To measure the rates of prevalence and incidence of cardiovascular diseases.

The plan of this study is based upon a longitudinal design that utilizes a cross-section of the population aged 30-59 on January 1, 1949. The study is expected to yield data over a period of 20 years, is organized as follows:[40]

First, it was felt desirable not to break up families; in other words, if one member of a family was included in the sample the rest of the members who satisfy the age requirements should also be included. The sample was drawn from a list of eligible people that, in turn, has been drawn from the town's directory of residents. This list was stratified by size of family and precinct of residence, and arranged in serial order in regard to address. The sample included 6,510 individuals who were selected from about 10,000 eligible persons. Initial examinations were completed for 4,469 individuals out of the 6,510 sought.

Second, the initial procedure carried out on each cooperating respondent included the following steps:[41]

1. An extensive medical history included:
   a. Family history of cardiovascular disease in mother and father, siblings, and children.
   b. A detailed past medical history of diphtheria, scarlet fever, sore throat, rheumatic fever, various chronic diseases, operations, thyroid diseases, presence of transient or permanent hypertension, heart murmurs, and "heart attacks", previous diagnoses

38 T R Dawber, F E Moore and G V Mann "Coronary Heart Disease in the Framingham Study" *American Journal of Public Health* 47, 4 4-24, 1957

39 T R Dawber, G F Meadors and F E Moore, "Epidemiological Approaches to Heart Disease The Framingham Study ' *American Journal Public Health,* 41, 3 279-286, 1951

40 See *Ibid.*, and T R Dawber, F E Moore and G V Mann, *op cit*

41 Dawber, Meadors and Moore, *op cit*, pp 283 284

of angina pectoris, limitation of activity due to heart disease, congenital heart disease, heart failure, vascular disease of any kind, enlarged heart, "nervous heart", pericarditis; and the history of any previous kidney disease, renal or hypertensive complications of pregnancy or of any menopausal symptoms.

c. Careful questioning for any current symptoms of heart or pulmonary diseases including cough, dyspnea, hemoptysis, smothering sensation, palpitation, chest pain and discomfort, edema, and phlebitis, etc.

d. Personal habits of the individual, including number of hours of sleep, amount of tobacco and alcohol consumed.

e. Average weight at five year intervals, beginning at age 25.

f. History of peptic ulcer, chronic colitis, nervousness, headache, and other symptoms suggestive of emotional upset.

g. Use of drugs or medicine.

2. A careful, detailed physcial examination performed independently by at least two physicians, aimed at detecting cardiovascular abnormalities or diseases related to the cardiovascular system, and measurement of characteristics which may be related to such disease including:

a. Height, sitting and standing, weight, antero-posterior diameter of chest, chest circumference, waist circumference, vital capacity, estimate of body build, color of eyes and hair, and distribution of hair and degree of baldness.

b. Skin color and degree of freckling, the presence or absence of sweating, clubbing of fingers and toes, cyanosis, exophthalmos, arcus senilis, xanthelasma, thyroid enlargement or tumors, chest deformity, and evidence of pulmonary disease.

c. Examination of the heart itself including description of heart sounds, murmurs, abnormal rhythm, blood pressure determinations on admission and at time of discharge, and at intervals during the examination by each of the examining physicians.

d. Examination of abdomen for tumors, liver enlargement, or palpable spleen.

e. Examination of the extremities for presence or absence of femoral pulse, dorsalis pedis and posterior tibial pulsations, ankle edema, varicose veins, and phlebitis.

3. X-ray examinations, teleoroentgenogram on "14 x 17" film and on 70 mm. film with two meter target distance.

4. An electrocardiogram using twelve leads.

5. Electrokymographic tracing at 12 points on the cardiac silhouette.

6. Examination of blood sample for:
   a. Hemoglobin
   b. Serum cholesterol
   c. Serum phospholipid
   d. S 10-20 fraction (of Gofman)
   e. Uric acid
   f. Glucose level
   g. Serologic test for syphilis
7. A routine urinalysis

Third, those who were classified as normals according to the results of these tests and the criteria of disease adopted, constituted the group to be followed up with subsequent biennial examinations conducted in a clinic maintained especially for this study.[42] Those who were found to have heart impairment were also followed up for the sake of good relations with the community.

Fourth, in the follow-up phases the health status of each person included in the initial phase was sought. Those who moved were brought under comparable tests. The health status for those who refused subsequent tests was sought through their relatives, neighbors and associates. Information was collected from medical examiners, state and local health departments and from clinical and autopsy reports in regard to the deceased sample constituents.

The Albany Study of Degenerative Cardiovascular Disease

This is another prospective longitudinal study of the heart with special emphasis upon "ischemic" heart disease.[43] The study was initiated in early 1953 by the New York Department of Health which contracted with the Albany Medical College for the establishment of a cardiovascular health center. The primary objective of this study and the Center was to "detect the earliest manifestations of degenerative cardiovascular disease" and to evaluate the different diagnostic techniques.[44] Prevalence rates, incidence rates and data related to etiologic factors were important by-products of the study.

Voluntary participation of a special population was solicited for this study. The population was constituted of male New York Civil Service employees, in the age range of 39-55, residing in the Albany area. Out of 2,202 eligible individuals, 1,913 participated in the initial medical examination, 1,757 participated in the second and 1,682 in the third. Intervals of about one year intervened between these exams. A wide variety of diagnostic and detection techniques was used in the study.

42 The criteria adopted are those of the New York Heart Association, with special modifications.

43 J. T. Doyle, A. S. Heslen, H. E. Hilleboe and P. F. Formel, "A Prospective Study of Degenerative Cardiovascular Disease in Albany: Report of the Three Years Experience—1. Ischemic Heart Disease." *Amer. Jour Public Health,* 47, 4: 25-32, 1957.

44 *Ibid.,* p. 25.

The Los Angeles Study

This study was initiated in Los Angeles, California, in 1949, by the California State Department of Public Health and the Los Angeles City Health Department, and assisted by the National Heart Institute.[45] The objectives of this study were primarily to appraise the sensitivity of various techniques to early detection of heart disease. Other by-products of the study were the measurement of prevalence and incidence rates, as well as measuring the degree of association of certain factors with the occurrence of the disease.

The service employees of the city of Los Angeles constituted the special population among which heart disease was investigated. A stratified sample, according to age and sex, was selected at random. The sample included 2,252 persons out of 20,199 eligibles. A proportion of 25 per cent refused to participate and were replaced by alternates from the same sex and age groups. The sample outcome included 1,859 males and 393 females among whom 1,899 were classified as white and 353 non-white.

The age composition of the sample ranged from 18 to 70 years. Each subject received an initial detailed examination and subsequent periodical examinations at intervals of 12 to 18 months. A variety of diagnostic techniques was utilized in the study.

The California Health Survey

An epidemiological investigation of coronary heart disease (420-0, 420-1 and 420-2) was reported as a by-product of the California Health Survey conducted in 1954-1955.[46] The survey covered a cross-sectional household sample of about 30,000 individuals in 10,000 households. Two hundred and fifty persons reported having coronary heart disease. This group in addition to randomly selected control groups, of matching age and sex, from the population of the California Health Survey was used as a basis for the epidemiological study. The objectives of this study were:[47]

> First, to obtain medical verification for the statement of diagnosis as reported by the respondent to the California Health Survey interviewer.
>
> Second, to obtain additional data about hypothesized etiological factors. Tests of the many current hypotheses in different settings may help to clarify their relative importance.

45 J. M. Chapman, L. S. Goerke, W. Dixon, D. B. Loveland and E. Phillips, "The Clinical Status of a Population Group in Los Angeles Under Observation for Two to Three Years", *Amer. Jour. Public Health*, 47, 4: 33-42, 1957.

46 R. M. Drake, R. W. Buechley and L. Breslow, "An Epidemiological Investigation of Coronary Heart Disease in the California Health Survey Population", *Amer. Jour. of Public Health*, 47, 4: 43-57.

47 *Ibid.*, p. 44.

Third, to describe the social impact of coronary heart disease.

A questionnaire seeking more information than that yielded by the Health Survey was sent to those who reported heart ailments as well as to constituents of the control groups. Forty-seven per cent of the mailed questionnaires were returned with satisfactory responses. An additional 36 per cent of these questionnaires were completed through interviews. Respondents were asked for an authorization for their physicians to submit medical data. Such data regarding respondents' health conditions were secured from 90 per cent of the physicians who were contacted. It should be noted that the initial identification of persons with coronary heart disease was based upon self-administered questionnaires used throughout the California Health Study.

The Purdue Study of the Farm Cardiac

This is a well coordinated interdisciplinary study, sponsored by Purdue University, Indiana and Northwest Indiana Heart Foundations, American Heart Association, Indiana State Board of Health and the National Institutes of Health. The study was planned with the following objectives:[48]

1. To determine energy requirements for doing specific farm jobs; to develop norms for energy output by task, age and environmental factors.
2. To measure changes in the physiological cost of doing jobs with changes in work methods.
3. To develop and evaluate easier, more effective and economical farm work methods for the worker with cardiovascular disease.
4. To classify farm jobs by methods according to energy requirements, to develop and evaluate alternative plans for organization and operation of farm business graded according to the physiological capacity of the farm work and to develop estimates of the earning potential of each alternative.

A field survey has evolved from this phase of physiological investigation. It was felt that the laboratory findings should be studied in a population of cardiac farmers. The field survey phase was carried out with the following goals:[49]

a. To generalize laboratory findings to the population of cardiac farmers.

b. To discover what jobs impaired workers are doing and relate activity to rehabilitation, health and productivity.

48 R L Eichhorn and W H M Morris, "Respondent Errors in Reporting Cardiac Conditions on Questionnaires", A paper presented at the meetings of The American Sociological Society, 1958

49 *Ibid*

c. To determine why physicians' instructions are or are not being followed and to develop guides for gaining acceptance of recommendations which physicians make.

d. To draw samples of impaired workers with known medical history for studies involving peak loads, heat stress and related measurements.

e. To provide data for developing and evaluating alternative plans of farm organization, graded according to the physical capacity of the farm work.

f. To contribute to the methodology of health surveys.

It is clear that the major emphasis, in this study, is upon the investigation of heart disease as an independent variable, i.e., the study of adjustment to cardiac impairment. There was no concern in this study about epidemiologic questions nor about the measurement of prevalence or incidence rates. The research design of this project reflects the emphasis upon the study of adjustment. A major interest for the investigators was to enrich their sample with cardiac farmers. The study utilized a cross sectional retrospective design rather than a longitudinal one. The study population was composd of farmers, and defined by the criteria of: (a) being 65 years of age or younger, (b) farming 80 acres or more, and (c) not working off the farm more than 100 days per year.[50] The study was started in one county and then extended to include four others. The plan of the study included the following steps:[51]

First: A health questionnaire, based upon the Cornell Medical Index Health Questionnaire, was mailed to 5,867 persons in the five counties. The names of those people were obtained from assessors' rolls and rural directories. The rate of return for these questionnaires was 78.8 per cent. Of these respondents, 62.3 per cent met the defining criteria of the population. From these eligible respondents 11.2 per cent reported having medically diagnosed cases of heart disease.

Second: A "purposive" sample, enriched by individuals who were more likely to have heart disease, was selected. Responses to the mail questionnaires provided the basis for determining the likelihood for a person to be having a heart disease condition. The sample included a little over 400 people.

Third: Interviews were conducted with sample constituents using a schedule that sought medical, economic, sociological and social psychological information related to the study objectives. Refusal rate in this step was 3.7 per cent.

Fourth: A medical examination was conducted for individuals who cooperated on step three. These examinations were made in a

50 L S Hardin, "Objectives and Techniques of the 400 Case Field Study" A paper presented at the Purdue Cardiac Seminar Purdue University, Lafayette, Indiana, September, 1958

51 *Ibid.*

mobile unit by a project physician, who was an internist or a senior resident in internal medicine. The State Board of Health provided a mobile X-ray unit to help complete this step. Only 4 per cent of those interviewed did not cooperate in the medical examination. A final sample of 397 individuals completed all steps included in the study.

The research design and important findings of this study were reported in a seminar, held especially for this purpose, at Purdue University in September, 1958. The proceedings of that seminar will be published in the near future.

RESEARCH DESIGN OF FIELD STUDIES

There are several aspects of research design to be considered in planning a field study. The most important aspects in developing a field study of heart disease are those related to objectives, duration, population, sampling methods and techniques of detecting heart disease cases. These facets of field study planning are the subjects for discussion in this section of the report. Studies reviewed in the previous section of the report will be drawn upon for examples and illustrations.

Objectives of Field Studies

One of the first steps in designing a field study is that of stating its objectives in clear, precise and scientific terms. The statement of objectives specifies the types of heart disease under investigation and the results expected from the study. According to objectives, field studies of diseases of the heart can be grouped into five categories: (1) studies of the magnitude of the heart disease problem; (2) studies in which heart disease is a dependent variable; (3) studies in which heart disease is an independent variable; (4) studies in methods and techniques of investigation, and (5) studies with other miscellaneous objectives.

Studies of the Magnitude of the Heart Disease Problem

In such studies the important objective is to measure prevalence and/or incidence rates of the type (s) of heart disease under investigation. Prevalence rates of a disease in a population indicate the proportion of persons with that disease in that population at a particular time.[52] Incidence rates are measured by "the rate at which new cases occur in the study population within specified intervals of time."[53] The measurement of prevalence and incidence rates provides

52 A. J. Thomas, A. L. Cochrane and I. T. Higgins, "The Measurement of the Prevalence of Ischaemic Heart Disease," *The Lancet,* Sept., 13, 1958, 540-544.

53 D. C. Miller, F. J Stare, P. D White and J. E. Gordon, "The Coronary Heart Disease· A Challenge for Epidemiological Research", *Am. Jour. of Med. Science,* 232, 3 329-359

the basis for disease control programs and other administrative purposes. These rates are also studied as parts of broader objectives.

Studies in Which Heart Disease is a Dependent Variable

The search in these studies is for identification of the independent factors upon which heart disease occurrence is dependent, or by which it is influenced. In other words, these are studies of the etiological factors of heart disease.

Epidemiological investigations are the most important etiological field studies. Several definitions have been given to the concept and the field of epidemiology. The following quotations are illustrative of what this field may encompass:

> It deals with "the fundamental questions as to where a given disease is found, when it thrives, where and when it is not found . . . in other words, it is the ecology of the disease."[54]
>
> It is the search for "causative factors . . . through greater familiarity with the natural history of the disease. Identification of those causes having their origin in characteristics of the human host and in the environment in which man lives is the special province of the epidemiologic method."[55]
>
> It includes the study of "the etiological factor, the mode of spread, the susceptibility and demographic characteristics of the affected population, along with the environment and heredity of the patients with the disease."[56]
>
> White adds "the relationship of the ways of life to disease."[57]
>
> More inclusively, "the epidemiological approach is used to explore certain relationships in health and disease which, with present technological methods, cannot be observed."[58]

Epidemiological studies have played an important role in the investigation of the natural history of rheumatic heart disease.[59] However, there is a great need for such studies in the area of heart disease, especially hypertensive and arteriosclerotic diseases of the heart.[60] Although epidemiological studies do not establish direct casual relationships between the disease and the factors investigated, such studies do point out the directions toward which detailed experimental work should be developed.

54 J. R Paul, quoted in T. R. Dawber, et al., *op. cit.*, p. 279.

55 D. C. Miller, et al., *op. cit.*, p. 330.

56 S. D. Collins, et al. *op. cit.*, p. 1.

57 D. White, *op. cit.*, p. 2.

58 T. R. Dawber, et al. *op. cit.*, p. 279.

59 J. R. Paul, *The Epidemiology of Rheumatic Fever*, The American Heart Association, Revised Edition, 1957.

60 For example see· T R. Dawber, et al. *op. cit*, p. 280; D. C Miller, et al. pp. 329-331 and P. D. White, *op. cit.*, pp. 2-3.

Studies in Which Heart Disease is an Independent Variable

The objective in these studies is to investigate the dependent variables that are caused or influenced by the presence of a heart disease impairment. The most important studies in this category are those of adjustment to heart disease. There are several types of rehabilitative practices which evolve also around the concept of adjustment.

Studies of Methods and Techniques of Investigation

In every field of investigation there are continuous efforts to improve the reliability and validity of the methods and techniques used in collecting data. There are several methodological problems characteristic of heart disease field studies. Some of these are statistical in nature, such as the adequacy and representativeness of the sample. Others are diagnostic, such as the techniques of identifying heart disease cases.

Studies Having Miscellaneous Objectives

Under this category can be included such studies as those concerned with public knowledge about heart disease, the attitudes of people toward diseases of the heart and toward those with heart impairments, and studies of the patient-doctor relationship and of the communication process.

Duration of Field Studies

Duration is not necessarily measured by the length of time consumed in completing a study, but rather by the number of observations included in the study. Studies designed for a single observation, such as the Hunterdon County and Baltimore studies are called cross-sectional. Longitudinal studies, on the other hand, are designed for multiple observations over a certain period of time, such as the Framingham and Albany studies.

Cross-sectional designs are easier to administer and far less expensive. They are suitable for estimating prevalence rates of a disease. They are used also in epidemiological and adjustment studies.[61] The disadvantages in the use of this type of design lie mainly in its failure to provide casual explanations. Some of these inadequacies can be overcome by the use of experimental designs which allow for collection of comparative data for experimental and control groups.

Longitudinal studies can be either prospective or retrospective in design. Prospective data are collected by working forward from an arbitrary date, as the problem occurs, while retrospective data are

61 See the California Health Survey and the Purdue Farm Cardiac studies pp 30-35 of this report

obtained by working backward, by the use of records and other means of reconstructing the events. It should be noted that prospective longitudinal designs are actually based upon cross-sectional observations at various points in time. Attrition presents an important problem in prospective designs, while retrospective data suffer more from low reliability and incompleteness of records. Both longitudinal designs can be used in estimating prevalence as well as incidence rates. The prospective type, however, is preferred by epidemiologists in detecting the natural history of a disease.[62]

Types of Populations

A study of population can be general or specific in respect to any given variable. For example, in respect to occupations a general population is that including a cross-section of the different occupational groups, while a specific one would be limited to a special occupational group. In this sense, any population is actually specific in regard to the space variable, unless it encompasses the total human race. Space limitations are present in almost every study which makes specification of that variable a matter of routine.

In regard to heart disease as a variable, a general population is that of a normal composition which includes those who have the disease and those who do not. A general population base is advantageous in cross-sectional epidemiological studies as well as in the administration of experimental designs. Several specifications can be made about the population in regard to heart disease. For example, a population can be specified as one that includes only those who have heart disease. Special types of heart disease also can be further specified. These specific populations can be used in studies of adjustment which a large number of individuals with heart disease conditions. Such populations, however, should include "all recognized cases within a prescribed universe of time and space, with chance variation in severity, extent of involvement, duration of illness and the characteristics imposed by biological and social differences among people."[63] In longitudinal studies, a specific population of normals is more appropriate for the collection of prospective data. In any case, criteria defining the study population should be clearly stated and consistently used in determining the eligibility of an individual to be included.

Sampling Methods

Sample adequacy and representatives are basic requirements for obtaining reliable data and attaining confidence in inferences and generalizations. The adequacy of a sample usually refers to its size,

62 D C Miller et al *op cit*, p 353
63 *Ibid*, p 351

and can be statistically examined and determined.[64] Representativeness of a sample, on the other hand, refers to its reproducability of the characteristics of the population. In order that inferences drawn from sample results can be generalized to a population, the sample should reproduce as closely as possible the characteristics of that population which are of primary interest.[65] Randomization offers the most adequate method of selecting representative samples for field studies.

There are several factors to be considered in planning the methods and techniques for drawing a sample for a heart disease field study. **First,** the objectives of a study constitute an important factor in the selection of the sample. For example, a random sample is necessary for estimating prevalence and incidence rates. In sampling for a longitudinal design, the effect of dropouts upon the results obtained should be carefully determined. Epidemiological studies can employ a wide variety of sampling methods. Cross-sectional random samples are the most widely used for that purpose. A random sample of normals is most suited for predictive longitudinal epidemiological studies such as that of Framingham, Massachusetts. Matched and equated experimental and control groups can be used also in field studies involving experimental designs.

Second, the characteristics of the variables under investigation present another consideration in determining the sampling methods. The important relevant characterstics of heart disease are those of its prevalence, distribution and identification. One of the high reported prevalence rates for diseases of the heart is 96 per 1,000 population.[66] This means that to obtain 250 cardiacs at random, the sample should be composed of at least 2,600 individuals. Stratified samples can be used to avoid handling such large numbers, especially if expensive medical evaluations are used in the study. Preliminary information about the population is gathered from symptoms-questionnaires or screening tests, and can provide bases for stratification.[67] In regard to the distribution of heart disease it is believed that "distribution of arteriosclerosis and hypertension in the white race in the United States is such that within-community variance is much greater than between-community variance, and a wide range of type-situations influencing development of these diseases may be found in any community".[68] The third important characteristic of heart disease, i.e., its identification, will be discussed in a later part of this section in the course of appraising the techniques of detecting diseases of the heart. The asymptomatic nature of several stages and types of dis-

[4] For example see M Parton, *Surveys, Polls and Samples — Practical Procedures,* Harper and Brothers, New York, 1949, pp 290 329

[5] F Yates, *Sampling Methods for Censuses and Surveys,* Charles Griffin and Company, London, 1953, p 9

[6] Commission on Chronic Illness Vol III, *op cit*, pp 78-79

[7] For example, see studies of the Commission on Chronic Illness in Baltimore and Hunterdon County

[8] T R Dawber et al *op cit*, p 281

eases of the heart present a chance for an interesting experimental design that utilizes the following four groups:[69]

1. The True Negatives: Those who think they are free of heart disease (negatives) and are found through medical evaluations to be free of the disease.

2. The False Negatives: Those who think they are free of heart disease, yet are found to have cardiac impairments.

3. The True Positives: Those who think they have a heart disease (positives) and are found to have the disease.

4. The False Positives: Those who think they have a heart disease and are found to be free of the disease.

Third, the characteristics of the population studied also influence the selection of sampling methods. The geographic distribution of population and the degree of its homogeneity-heterogeneity in regard to the relevant variables affect the sampling plans. Area sampling techniques have proved to be more suitable for studies of wide geographic coverage.[70] However, this type of sampling design has important economic and practical limitations, especially in studies involving clinical evaluations. Investigators resort to concentration upon limited geographic locales such as a town, community or a county to avoid the problem of wide distribution. These limited locales can be chosen on the basis of typicality, representation according to certain variables, comparative designs or just mere convenience. The degree of homogeneity-heterogeneity of the population partially determines the adequate size of a sample.

There are other practical and economic factors to be considered in planning methods of sampling. The available time, finances and personnel are examples of such determining factors in sample planning.

Techniques for the Detection of Heart Disease

In any study of diseases, the reliability of the collected data is largely determined by the sensitivity and consistency of the techniques employed in identifying these diseases. The devices being used for the detection of heart disease can be grouped under three main techniques: (1) questionnaires and interviews, (2) screening tests, and (3) diagnostic examinations.

Questionnaires and Interviews

This technique is based upon the knowledge of people and their evaluations in regard to the conditions of their health. It takes the form of questions about specific symptoms and usually includes

69 See Commission on Chronic Illness, *op cit*, p 221, and R L Eichhorn and W M Morris *op cit*

70 M J Hagood and D O Price, *Statistics for Sociologists*, Henry Holt and Company, 1952, pp 310-312

others about the medical history of the respondent. This information can be solicited by either mailed questionnaires or by direct interviews with the respondents.

Existing morbidity data have been collected mainly by means of this technique presumably on the premise that "if a person believes himself to be ill, he should be considered so." The relatively lower cost and easier administration of this technique enhanced its popularity among health surveyors. Recently, however, the reliability of this approach has been challenged and tested. Two main sources of error can be distinguished in the application of any technique of detecting a disease. The first source of error is that of failing to detect the disease in individuals who have it. The margin of this error is measured by the proportion of false negatives.[71] The second type of error results from the erroneous inclusion of normals among those reported as having the disease. The magnitude of this error is measured by the proportion of false positives. The terms "adequacy" and "accuracy" have been used also in describing the degree of freedom of techniques from the first and second types of error respectively.[72] In general it would be expected that the degree of utility (adequacy and accuracy) of the questionnaire and interview technique would be higher when several diseases are involved rather than one disease only, and when diseases are being symptomatic rather than asymptomatic.

This technique has been subjected to rigorous tests in regard to its sensitivity to the detection of heart disease. In the Los Angeles study of the city service employees this approach detected 62.5 per cent of the heart disease cases.[73] However, the proportion of false positives has amounted to a high of 31 per cent. Three questions on the form used in that study were found to work together as a unit which detected 50 per cent of the cases and reduced the false positives to 18 per cent.[74]

The percentage of adequacy obtained in household interview reports about heart disease cases, when compared to results of clinical examinations, were 39 and 38 per cent in the Hunterdon County and Baltimore study respectively. These figures represent "the percentage of clinically diagnosed conditions previously reported in household

71 H. F. Dorn, "Methods of Measuring Incidence and Prevalence of Disease", *Am. Jour. Pub. Health,* 41, 3: 271-278, 1951.

72 J. Elinson and R. Trussell, *op. cit.,* p. 315.

73 E. Phillips, J. M. Chapman and L. S. Goerke, "Relative Values of Techniques Used in Detection of Heart Disease", *Am. Heart Jour.,* 45: 319, March, 1953.

74 These three questions are:

1. Do you ever have distress, pain or uncomfortable feeling in the chest while walking on the street or up inclines or steps? . ...Yes .....No *If yes,* at what age did you first notice it?. ....

2. While walking are you forced to stop in order to rest? ....Yes ....No
If yes, is it because of ....Distress in the chest?
....Shortness of breath?
.. ..Both?

3. Have you noticed increasing or undue shortness of breath with exertion? .....Yes ....No
If yes, at what age did you first notice it? ....

interviews."[75] The accuracy rates for the same two studies were 80 and 84 per cent respectively. These figures indicate the "per cent of household interview reported conditions subsequently diagnosed by clinical examination".[76] Lower rates of adequacy and accuracy of 13 and 70 per cent respectively were reported from a study in Pittsburgh.[77] The Purdue research group, however, found a high accuracy rate of 71 per cent and a low accuracy rate of 65 per cent. The high adequacy rate may be the result of depending mainly upon the response to the question of whether the respondent has ever been diagnosed as a cardiac.

In the Baltimore study, no significant difference was found in the reliability of reporting of total diseases between those who reported about themselves and those who reported about other members of their families. A considerable difference existed, however, in reliability in the reporting of heart disease, with "other respondents" being more accurate than "self respondent". Female reporting in total heart disease cases was more reliable than that of males. There were significant age and race differentials in the reliability of reporting heart disease with whites exceeding non-whites and those over 65 years of age exceeding those under that age. The reliability in reporting was found also to be positively associated with the degree of severity of heart disease; i.e., those with severe conditions were more correct in their reporting than others with milder cases.[78]

These results indicate that the questionnaire and interview technique suffer from low reliability in under reporting rather than over reporting and from instability in findings. The following statements include evaluative conclusions reached by some investigators about the value of this technique as a tool for the detection of disease:

> The conclusion reached here is that the lay interview is not now, or likely soon to become a valuable tool for measuring the prevalence of diagnosable chronic disease.[79]

> The data at hand suggest that, for chronic disease, household interviews may be expected at best to provide minimum estimates of morbidity.[80]

There are other investigators who maintained somewhat more optimistic views about the usefulness and possible improvement of the interview technique.[81] In an effort toward the improvement of

75 J. Elinson and R. E. Trussell, *op. cit.*, p. 315.

76 *Ibid.*

77 Reported in *ibid.*

78 Commission on Chronic Illness, *op. cit.*, pp. 295-328.

79 E. D. Krueger, "Measurement of Prevalence of Chronic Disease by Household Interviews and Clinical Evaluations," *Am. Jour. Pub. Health*, 47, 8: 953-960.

80 R. E. Trussell, J. Elinson and M. L. Levin, *op. cit.*

81 See E. Phillips, J. M. Chapman and L. S. Goerke, *op. cit.*

this technique Eichhorn and Morris pointed out the following sources of errors:[82]

1. The failure to recognize a health condition.
2. The misinterpretation of recognized health condition.
3. The inability to describe a health condition.
4. Errors in the translation of responses into a medical classification.

The improvement of this technique would require item analyses to show the detection ability profile of the different items used in these various studies. Although the sensitivity of this technique can never reach those of clinical tests, yet it is believed that with improvement it can become a useful screening tool by itself or in combination with other tools such as the electrocardiogram.

Screening Tests

This technique was originally developed for use in the field of preventive medicine to differentiate between those who are likely to have abnormalities and those who probably do not.[83] The difference between the screening tests and diagnostic evaluations should be noted. Screening procedures are "simply presumptive tests utilized to screen persons who upon further examination may be proved to have a chronic disease (in this case heart disease), in order to reduce the number of persons to whom the definitive diagnostic procedure need be applied."[84] The two types of error described in the questionnaire and interview technique are also applicable to screening tests. These errors result in the failure to detect some of the existing cases (false negatives) and the referral of some normals (false positives) to diagnostic tests.

Several screening tests are used singly and in combinations to detect the probability of the existence of a heart disease. These include tests such as the electrocardiogram (EKG), the electrokymogram (EKY), 70 mm. Chest X-ray, fluoroscopy of the chest, blood pressure, the level of serum cholesterol, blood tests for sugar and others. Improving and testing the reliability and validity of these tests have been the subject of many efforts. There is a definite need for more work along these lines, however.

In the Baltimore study the EKG, using the three standard limb leads and the three chest leads (V1, V3, V5) routinely and six chest

82 R L Eichhorn and W M Morris, 'Respondents Errors in Reporting Cardiac Conditions on Questionnaires' A paper presented to the Farm Cardiac Seminar, Purdue University, September, 1958

83 Commission on Chronic Illness, *op cit.*, p 221

84 M L Levin and I J Brightman, 'The Place of Multiphasic Screening in the Chronic Disease Program" *New York State Jour Med.* 52 2600-2640

leads occasionally, was able to detect 52 per cent of diagnosable heart disease cases. Out of every 100 persons examined in this study, the EKG tests produced an error of 5.5 per cent false positives and 4.0 per cent false negatives.[85]

In the Los Angeles study of city employees, Phillips and his associates reported that electrocardiography with the three standard limb leads detected 57 per cent of diagnosable heart disease cases. An increase to 12 leads improved the detection ability of the electrocardiogram to 65 per cent. These investigators maintain that such a little improvement as compared to the technical skill required in the use of the extra leads does not justify their use in mass screening. The detectability of the EKG in this study was highest in cases with unknown etiology and in those of hypertensive heart disease with 66 and 64 per cent respectively. Lower detectability of 45 and 44 per cent was reported for coronary-arteriosclerotic and rheumatic diseases of the heart respectively. A combination of electrocardiography and questionnaire forms was able to detect over 90 per cent of diagnosable heart disease cases in this study. These investigators found also that the blood tests, urinalyses and vital capacity determinations did not contribute to the detection of heart disease. The values of the EKY and lipoprotein tests were held in doubt. Most cases detected by the 70 mm. chest X-ray were reported by other techniques. The medical history form, the EKG, the physical examination and the fluoroscopic tests contributed equally to cardiac case finding, with the last two tests being free of errors.[86] A high detection power was reported also by other investigators for photofluoroscopic tests.[87] However, the skill required in the administration of fluoroscopy and physical examinations excludes them from being used as screening tests.

Studying ischemic heart disease among New York State Civil Service employees in the Albany area, the research team arrived at the following conclusions:

> A carefully evaluated medical history is still the single best method of diagnosis. The electrocardiogram provides valuable confirmatory evidence of ischemic heart disease; non-specific abnormalities of the T wave appear to be of prognostic importance; a significant number of diagnostic electrocardiographic abnormalities can be induced by exercise.[88]

It can be concluded from this discussion that electrocardiography is probably the most practical single instrument in screening for heart disease. The EKG can be combined with other tests of high detectability to improve the reliability of the screening procedure.

85 Commission on Chronic Illness, *op cit*, pp 249 254

86 E Phillips, et al *op cit*, p 325

87 D D Rutstein, G R Williamson and F E Moore, "Heart Disease Case Finding by Means of 70 Millimeter Photofluorographic Films Group 1" *Circulation*, 4 641-651 November 1951

88 J T Doyle, et al *op cit*, p 31

The improvement of these instruments and the development of more precise and reliable criteria for interpreting the results of these tests constitute an important area for research.

Diagnostic Tests

The results of these tests provide the most definitive medical evaluations. They usually include medical histories, physical examinations and several other tests of those used in screening. In some cases diagnostic evaluations include more refined tests such as enzyme blood tests. Time and money costs in the administration of these tests discourage their application in mass examination. However, diagnostic tests have been used in several comprehensive studies such as those of Framingham, Albany, Purdue, Los Angeles and the Commission on Chronic Illness. The rigor of these tests depends upon the details needed for the field study.

REVIEW OF FINDINGS

Communication of findings is an essential step in the development of fruitful research programs for testing existing hypotheses or searching for new ones. This section of the report is devoted to a review of the important findings reported in the literature at hand. In this presentation, findings will be classified according to study objectives.[89] Findings related to methods and techniques of investigating heart disease have been the subject of discussion in the previous section of this report. The four other categories of objectives for which findings will be presented are: (1) the study of the magnitude of the heart disease problem, (2) the study of heart disease as a dependent variable, (3) the study of heart disease as an independent variable, and (4) other miscellaneous objectives. It should be pointed out that the various findings reported here were not obtained by the use of entirely comparable methods and techniques.

Findings Related to the Magnitude of the Heart Disease Problem

The magnitude of the problem of a disease is usually measured and expressed in terms of prevalence and/or incidence rates for mortality and/or morbidity caused by that disease. Several interpretations have been advanced to explain the fact that diseases of the heart rank first among causes of death in the United States as a whole as well as in most individual states. The more comprehensive of these explanations are the ones relating the climbing heart disease death rates to: (1) the development in medical nomenclature and methods of diagnosis, (2) the improvement in methods of recording causes of death, (3) the relative decrease in deaths by other diseases due to the advancement in methods of their control, and (4) an

89 See page 36 of this report

actual increase in the incidence of heart disease. In any case diseases of the heart as demonstrated in Table 1 have been of first importance as a cause of fatalities in the United States during the last decade. The table shows that these diseases account for over one-third of all deaths and that their percentage is in gradual increase.

Table 1.
Death Rates Per 100,000 Population in the United States (excluding the Armed Forces) from All Causes and from Diseases of the Heart

	1950	1951	1952	1953	1954	1955	1956*
All Causes	963 8	966.3	961.0	958.5	918.9	930.4	936.1
Diseases of the Heart (410-443)**	355 5	355.8	356.4	360.2	347.5	355.8	361 8
Per Cent	36 9	36 8	37.1	37.6	36.8	38.2	38.7

* Estimated

** The figures refer to the ISC code numbers

Source N O V S *Estimated Numbers of Deaths and Death Rates for Selected Causes — United States 1956*, Vol 5, No 13, May, 1957, pp 10 11

Over two-thirds of deaths by heart disease are caused by arteriosclerotic heart disease including coronary disease. Hypertensive heart disease as a cause of death occupies second rank among diseases of the heart. Death rates by the different types of heart disease for years 1955 and 1956 are presented in Table 2.

Table 2.
Distributions of Death Rates Per 100,000 in the United States by Types of Heart Disease*

Type	1955	Percent	1956**	Percent
All diseases of the heart (410-443)*	355.8	100.0	361.8	100.0
Chronic rheumatic heart disease (410-416)	11.3	3.2	11.3	3.1
Arteriosclerotic heart disease including coronary (420)	247.0	69.4	256 5	70.9
Non-rheumatic chronic endocarditis and other myocardial degeneration (421-422)	39.9	11 2	37.1	10.3
Hypertension with heart disease (440-443)	45.0	12.6	43.9	12.1
Other diseases of the heart (430-434)	12.6	3.5	12.9	3 6

* The figures refer to the ISC code numbers

** Estimated

Source N O V S , *Estimated Numbers of Deaths and Death Rates for Selected Causes — United States 1956*, Vol 5, No 13, May, 1957, p 10

In contrast to data on death rates, the findings of morbidity surveys differ among themselves, according to their populations and methods of investigation. The National Health Survey shows diseases of the heart as second only to rheumatism in the estimated number of morbid cases in 1937. In the same survey heart diseases were found to occupy third position among causes of chronic illness in the estimated number of invalids and days lost because of such illness. Nervous and mental diseases occupied first rank with rheumatism second in both of these estimates.[90] More recent data obtained from the study of chronic illness in Baltimore with the use of medical evaluations indicate that heart disease occupies second position as a cause of chronic illness with a prevalence rate of 96.4 per 1,000 persons. Mental disorders constituted the highest prevalent cause of chronic illness among the study population with a rate of 108.6 per thousand persons. In a descending order after heart disease, there

Table 3.
Prevalence Rates of Heart Diseases in Selected Studies Using Clinical Tests

Study	Rates per 1,000		
	Male	Female	Total
Baltimore			
All Heart Disease	102.0	92.1	96.4
Coronary Artery Disease and Angina Pectoris	30.8	16.7	22.5
Hypertensive Heart Disease	41.3	57.0	50.2
Other Heart Disease	29.7	18.6	23.7
Framingham			
Arteriosclerotic Heart Disease	23.7	11.5	17.0
Myocardial Infarction	8.4	.4	4.0
Angina Pectoris	9.9	7.4	8.5
Possible Myocardial Infarction	5.4	3.7	4.5
Albany			
Ischemie Heart Disease	36.6	—	—
Myocardial Infarction	19.3	—	—
Angina Pectoris	9.4	—	—
Abnormal (EKG) Response to Exercise	7.8	—	—
Los Angeles			
All Heart Disease	79.1	45.8	73.3
Hypertensive Heart Disease	30.7	25.4	29.8
Coronary Occlusion and Hypertensive Heart Disease	12.4	7.6	11.5
Coronary Heart Disease	14.5	5.1	12.9
Other Heart Disease	21.5	7.6	19.1

90 National Health Survey, "The Magnitude of the Chronic Disease Problem in the United States," *Sickness and Medical Care Series*, Bulletin 6, The National Institute of Health, revised, 1939

Table 4.
Incidence Rates of Heart Diseases in Selected Studies Using Clinical Tests

Study	Period Incidence Per 1,000			Annual Incidence Per 1,000		
	Male	Female	Total	Male	Female	Total
Framingham*						
All Arteriosclerotic Heart Disease	32.9	13.2	22.1	8.2	3.3	5.5
Myocardial Infarction	15.2	1.7	7.7	3.8	.4	1.9
Coronary Occlusion w/o information	6.6	.4	3.2	1.7	.1	.8
Myocardial Fibrosis with death	1.0	.4	.7	.2	.1	.2
Angina Pectoris	10.1	9.9	10.0	2.5	2.5	2.5
Possible Myocardial Infarction	—	.8	.5	—	.2	.1
Albany**						
All Ischemie Heart Disease	21.7	—	—	8.4	—	—
Myocardial Infarction	11.9	—	—	4.6	—	—
Angina Pectoris	5.4	—	—	2.1	—	—
Abnormal (EKG) Response to Exercise	4.3	—	—	1.7	—	—
Los Angeles***						
Coronary Heart Disease	23.6	8.5	20.9	9.4	3.4	8.4

* Period — 4 years
** Period — 31 months
*** Period — 30 months

were the following diseases with the indicated prevalence rates per 1,000 population: arthritis 75.2, hypertension without heart involvement 66.4, neoplasms 54.9, syphilis 36.5 and diabetes with a rate of 26.7.[91]

Table 3 shows the prevalence rates of morbidity by various types of heart disease as reported in four major field studies that employed diagnostic tests in evaluating health conditions of their samples. Table 4 includes incidence rates of morbidity by some diseases of the heart as reported in three longitudinal studies. Data presented in this last table show incidence rates for the period of study reported, as well as the annual rate of incidence of the disease.

91 Commission on Chronic Illness, *op. cit*, pp 75-103.

Findings Related to Heart Disease as a Dependent Variable

It has been mentioned previously that heart disease is treated as a dependent variable in studies of etiological factors and conditions. The causality of certain types of heart disease, such as rheumatic and syphilitic diseases, has been considerably solved. On the other hand, causal explanations for the most important diseases of the heart, the noninfectious-noncongenital ones such as arteriosclerotic, coronary and hypertensive diseases, are far from being conclusive. However, existing knowledge indicates that a multiplicity of causative factors are implicated in the etiology of these diseases. The following paragraphs include a discussion of research findings that are related to a number of selected etiological factors.[92] These factors are classified into four arbitrary categories including: biological, demographic, socio-psychological and other factors. It should be noted that in such broad categorization, a certain amount of overlapping is expected to occur.

Biological Factors

This category includes such features as infectious agents, heredity, nutrition, energy expenditure, blood pressure and obesity. This group of factors has been given considerable attention in clinical and laboratory research. Several of these factors also have been the subject of epidemiological investigations.

Infectious Agents: Although the basic etiological process is still unclear, the relationship between group A hemalytic streptococci and rheumatic heart disease, a frequent feature of rheumatic fever, is well established.[93] Aside from that, there is a definite lack of evidence of any direct etiological relationship between infectious agents and other major types of heart disease.

Heredity: Heredity is considered by some investigators to be a factor of major significance in the etiology of coronary heart disease.[94] Results obtained by these researchers show that among a group of 100 patients with coronary heart disease, 67 per cent were found to have a positive family history of the disease in comparison with 40 per cent positive histories that were found for families of a similar but unmatched group of persons free from that disease. More prevalent family histories with cardiovascular diseases among coronary patients than in the general population have been reported also in other studies.[95] Miller and his associates consider efforts to establish a

92 For more detailed discussion of such factors see: D. C. Miller et al. *op. cit.*, pp. 337-350.

93 H. F. Swift, "Rheumatic Fever", *The Encyclopedia Americana*, Vol. 23: 459-561, 1957.

94 H E. Russek and B. L. Zohman, "Relative Significance of Heredity, Diet and Occupational Stress in Coronary Heart Disease of Young Adults", *Am Jour. Med. Sc.*, 235, 3: 266-275, March, 1958.

95 D. C. Miller et al. *op. cit.*, pp. 342-343.

relationship between hereditary and coronary disease as "unconvincing." They also conclude that, although empirical results are inconclusive, they provide reasonable grounds for suspecting heredity as a contributing factor to the development of susceptibility to the disease, either directly or through other diseases such as diabetes and familiar hypercholesteremia.[96]

Nutrition: Considerable attention has been given recently to the study of effects of nutritional material upon the development of atherosclerotic heart disease and coronary thrombosis. Most of the findings related to this factor are obtained from biochemical and physiological laboratory research work. A central object of attraction to investigators in this area is cholesterol metabolism. Chemical differences among types of fats in a diet are found to be more important than their origin whether animal or vegetable. Certain unsaturated fatty acids were found to lower the level of blood cholesterol while saturated ones were found to lead to hypercholesteremia.[97] Although the mechanisms involved in these processes are still in hypothetical stages, yet epidemiological as well as laboratory studies have demonstrated a close association between the level of serum cholesterol and the incidence of arteriosclerotic heart disease.[98] However, a recent study concluded that neither fat nor protein has any significant effect upon the level of serum cholesterol among women.[99]

Scrimshaw maintains that conclusions in regard to the relationship between nutrition and heart disease, that are drawn from studies made exclusively within the United States, are of limited importance due to the low variability in dietary habits within this country.[100] He advocates comparative studies with the use of samples from different countries. The work of Tejada and Gore is given as an example for such international research work. Among 600 collected aortas of dead persons in New Orleans and 300 in Guatemala, both groups from the low income classes, earlier development of every type of aortic atherosclerotic lesion and consequently the involvement of more extensive areas at each decade of age were found in the New Orleans material. Fifty-one cases of myocardial infarction were found among the New Orleans group as compared with only one case among the Guatemalans. The major difference in diet between the two groups lies in the amounts and types of fat and protein. In general these two nutritional components constituted about 40 per cent of the calories consumed by those of New Orleans, but not more than 15 per cent of the Guatemalan diet.[101]

96 *Ibid*, p. 343.

97 *Ibid.*, p. 346.

98 For example, see T. R. Dawber et al. *op. cit.*, pp 15-16; J. T. Doyle et al *op. cit.*, p. 30, and E. Phillips et al. *op. cit.*

99 L.C. Butler, M. T. Childs and A. J. Forsythe, "The Relation of Serum Cholesterol to the Physical Measurement and Diet of Women", *Jour. of Nutrition*, 59: 469-479, August, 1956.

100 N. S. Scrimshaw, "Implications to the Nutritionist", *Am. Jour. Pub. Health*, 47, 4: 60-62, April, 1957.

101 *Ibid.*, p. 60.

Energy Expenditure: Excessive energy expenditure was found to have adverse effects upon angina pectoris, while sedentary physical activity was found to be associated with myocardial infarction.[102] Raab explains the relationship between physical activity and coronary heart disease by the functions of two amines that are found in the heart muscle. These two amines are (a) the epinephrin which is an oxygen-wasting material and is found in higher concentration in hearts of persons with sedentary physical activity, especially those with coronary heart disease, and (b) the norepinephrin which promotes the efficiency of oxygen utilization and is found in higher concentration in the hearts of athletes.[103] Although the effect of physical activity upon cardiacs is recognized by physicians and rehabilitation specialists, yet the etiological relationship between the two variables is still indefinite.[104]

Blood Pressure: The role of hypertension in the etiology of hypertensive heart disease is well recognized. Hypertension is considered as an etiological factor of heart disease, only when both systolic and diastolic pressures are elevated. The first should be persistently above 140 mm. Hg., and the second above 90 mm.[105] Recent epidemiological studies demonstrate an association between high blood pressure and arteriosclerotic heart disease. In the Framingham study, blood pressure was found to be clearly associated also with the risk of coronary disease even in the absence of elevation of cholesterol level or relative weight.[106] Similar findings were reported by the Los Angeles study investigators.[107]

Obesity: Data of life insurance companies have directed the attention to obesity as being associated with shorter life expectancy. Among other diseases, heart disease was found to affect life expectancy of obese people.[108] Other findings that support this relationship exist.[109] However, contrary findings, denying such an association between excessive weight and coronary heart disease, are also reported.[110] The clarification of this problem is obstructed by the complexity of variables that are related to obesity such as physical activity, diet, metabolism and the association with certain diseases especially hypertension and diabetes. In spite of these discordant findings, it is generally accepted that reduction in weight is beneficial to obese people who have heart disease or are susceptible to it.

102 J N Morris et al. *op. cit.*, pp 1053-1057.

103 D C. Miller et al. *op. cit*, p 349

104 *Ibid*

105 Criteria Committee of the New York Heart Association, *op. cit*, p 17

106 T. R. Dawber et al. *op. cit*, p. 18.

107 J. M. Chapman et al *op. cit*, pp 40-41

108 H H. Marks, "Relationship of Body Weight to Mortality and Morbidity," *Metabolism*, 6, 5: 417-424, September, 1957.

109 For example, see T R. Dawber et al. *op. cit.*, pp. 14-15; D. C. Miller et al. *op. cit*, p. 342, and J. T. Doyle et al *op cit.*, p. 30.

110 D C.Miller et al. *op cit.*, pp 342-343.

Demographic Factors

These are the most widely used factors in analyses of mortality and morbidity data. Breakdowns by sex, age and race are common in most field studies and vital statistics reports. Marital status and type of population (rural-urban) also are used occasionally.

Sex: Sex differentials in mortality rates of arteriosclerotic heart disease among whites under 55 years of age are greater than those of any other demographic factor.[111] Although male mortality from ASHD (all ages) maintains higher total rates, the gap between the two sexes tends to close beyond the age of 55.[112] This phenomenon is generally attributed to the functions of ovarian hormones. The relatively higher rates of development of coronary atherosclerosis in younger ages among oophorectomized women, and the lower than expected rates of development of the disease among women with hyperestrogenism, support the hormone protective action hypothesis. Confirmatory evidence was reported in the form of lower rates of development of the disease among men treated with estrogens.[113] Morbidity data, as shown in Tables 3 and 4, also indicate differences between males and females in the rates of prevalence and incidence of arteriosclerotic and coronary heart disease. However, a higher proportion of women tend to develop angina pectoris than other types of arteriosclerotic and coronary diseases of the heart. It is suggested that certain environmental factors affect the degree of sex differences in susceptibility to heart disease. This hypothesis is based upon sex differences in the rates of mortality by ASHD among Italians and Portuguese which were found to be closer to those of non-whites in the U. S. and lower than those of the whites.[114]

Sex differential in mortality by hypertensive heart disease is reversed in direction, with women exhibiting higher total rates (all ages) than men.[115] Prevalence rates of hypertensive heart disease among the Baltimore study population demonstrate a similar trend.[116] The age adjusted rates of illness by this type of heart disease reported in that study were 41.3 per 1,000 persons for men and 57.0 for women. The same study shows also higher rates of susceptibility to hypertension, without heart involvement, among women than men. Contradictory results, showing higher rates of hypertensive heart disease among men than women, were reported by the Los Angeles study group.[117] These results, however, can be attributed to the selected nature of the population studied in Los Angeles.

111 E. A. Lew, "Some Implications of Mortality Statistics Relating to Coronary Artery Disease." *Jour. Chron. Disease.* 6, 3: 192-209, Sept. 1957.

112 See N.O.V.S. reports about mortality classified by sex and age.

113 C. D. Miller et al. *op. cit.*, p. 339.

114 E. A Lew, *op. cit.*, pp. 199-200.

115 See N.O.V.S. mortality reports.

116 Commission on Chronic Illness, *op. cit.*, pp. 83-84

117 J. M. Chapman et al. *op. cit.*, pp. 34-35.

No significant differences are manifested between males and females in mortality or morbidity rates of rheumatic heart disease. Other diseases of the heart tend to develop at a higher rate among men than women.[118]

Age: Rates of heart disease fatalities are closely associated with age as demonstrated in Table 5. The degree and form of this association differ from one type of heart disease to another.

A sharp increase in death rates of arteriosclerotic including coronary heart disease occurs at the period of 45-54 years of age. A similar pattern is characteristic of hypertensive heart disease mortality rates. On the other hand, rheumatic heart disease rates of fatality show a gradual increase with age. Reports on heart disease morbidity indicate similar pattern of relationship between age and illness from these diseases.[119]

Table 5.
Mortality Rates of Heart Disease (410-443) per 100,000 Persons Classified by Age and Marital Status

Age Group	Total	Single	Married	Widowed	Divorced
Under 20	2.7	2.6	5.9	52.0	4.7
20-24	8.1	9.8	6.3	38.8	10.4
25-34	19.7	32.7	16.4	62.8	33.5
35-44	86.3	138.0	76.6	159.6	144.9
45-54	308.0	404.2	283.5	401.0	458.9
55-59	641.9	786.9	608.9	671.0	945.4
60-64	999.8	1186.7	948.4	1022.5	1448.8
65-69	1480.6	1699.1	1412.3	1448.5	2280.8
70-74	2334.0	2613.7	2217.3	2326.5	3544.7
75 and over	2013.5	5443.7	4195.6	5338.5	7037.2

Source: N.O.V.S. Department of Public Health, Education and Welfare, *Mortality from Selected Causes by Marital Status* — United States 1949-1951, 39, 7: 303-492.

Race: The relationship between the rate of heart disease occurrence and racial differences is still indefinite. Below the age of 45, no significant difference exists between whites and non-whites in death rates by arteriosclerotic heart disease. Over that age, mortality rates by this disease among non-whites tend to fall below those among whites. The difference in ASHD mortality rates among females present a somewhat different picture. Rates for non-white females are significantly higher than those of white females, until the age of 65 at which the pattern is reversed, i.e., the rates for non-whites fall below those of the whites. Under reporting and living in areas characterized by low rates of heart disease, among other factors, are

118 For example see: Commission on Chronic Illness, *op. cit.*, p. 83 and N.O.V.S. Mortality Reports.

119 For example see: J. M. Chapman et al. *op. cit.* p. 35; T. R. Dawber et al. *op. cit.*, p. 9; J. T Doyle et al. *op. cit.*, pp. 26-27 and R. M. Drake et al. *op. cit.* pp. 45-47.

believed to influence the rates of non-whites.[120] Mortality rates of hypertensive heart disease are higher among non-whites than among whites.[121]

Findings of investigators of chronic illness in Baltimore show higher age adjusted rates for total diseases of the heart among non-whites than among whites.[122] These rates are 112.0 and 92.1 per 1,000 persons respectively. Rates of illness by hypertensive heart disease in that study were found to follow the same pattern, with higher rates of 98.0 per 1,000 among non-whites as compared to those of 38.4 per 1,000 among whites. In the case of coronary artery disease and angina pectoris, the rate among whites which was 25.8 per 1,000 exceeded the 3.3 per 1,000 rate found among the non-whites. Illness rate for other diseases of the heart was also higher for whites with 28.9 per 1,000 in comparison to that among non-whites whose rate was 9.4 per thousand.

These findings suggest a racial differential in susceptibility to diseases of the heart. They also indicate that the pattern and degree of those differences vary from one type of heart disease to another. However, a comparative analysis of mortality data from different parts of the world tends to minimize the influence of racial differences upon the course of heart disease.[123]

Marital Status: This factor has not been given sufficient attention in general morbidity or special heart disease studies. However, analyses of mortality statistics (see Table 5), consistently favor the married with lower heart disease death rates than the single, widowed or divorced. Lower rates of fatalities are found also for the married in all types of heart disease reported individually except in arteriosclerotic including coronary disease of the heart (420) where rates among the widowed between ages 45 to 74 fell below those among the married in the same age groups.[124] Whether marital status is a causal factor in the etiology of heart disease, or these findings are the result of biological and environmental selectivity, is a problem that remains to be solved.

Size of Locality: The rate of heart disease fatalities demonstrates some degree of association with the size of locality. Table 6 shows that higher death rates are found in localities of larger sizes. Although these rates may reflect in part the differences in adequacy of diagnosing and reporting causes of death, yet consistency in the relationship between the two variables provides reasonable grounds for suspecting the environmental differences between large and small localities as a differential factor in heart disease occurrence. It is expected that findings in the Hunterdon County study as compared with those in the Baltimore study will give a clearer picture about the differences between rural and urban localities in the prevalence of heart disease.

120 E. A. Lew, *op. cit.*, p. 200.

121 N.O.V.S., *op. cit.*, p. 404.

122 Commission on Chronic Illness, *op. cit.*, pp. 84-85.

123 United Nations, *Demographic Year Book* 1955 United Nations, New York, 1956.

124 N.O.V.S. *op. cit.*, p. 400.

Table 6.
Mortality Rates per 100,000 Persons from Heart Disease* 1940,
By the Size of Locality**

Size of Locality	Total	Male	Female
100,000 and over	346.8	419.3	279.5
10,000 - 99,999	303.7	377.9	237.2
2,500 - 9,999	289.6	363.5	221.3
Less than 2,500	237.9	274.1	196.5

* The ISC code for heart disease (all forms) included those with numbers 90 to 95 of the fifth revision.

** Source: M Gover, "Mortality From Heart Disease (All Forms) Related to Geographic Section and Size of City", *Pub. Health Reports*, 64, 14: 439-456, April 1949

Socio-economic and Socio-psychological Factors

A wide variety of factors can be included under this heading. Occupational differences and income levels are among the more investigated factors as to their relationship to heart disease.

Occupational Differences: Inaccuracies characteristic of methods of reporting occupations on death certificates limit the reliability of results obtained from occupational analyses of mortality data.[125] Morris and his associates found occupational differential in the occurrence of coronary heart disease among London Transport personnel as well as among postal workers.[126] The investigators attributed their findings to differences in the physical demands of the different jobs, yet this hypothesis remains to be confirmed. Results reported by the Los Angeles study group indicate that occupationally-associated physical requirements do not demonstrate significant influence upon the development of coronary disease.[127] Emotional stress associated with certain jobs and responsibilities has been also suspected by physicians as a factor related to the etiology of heart disease. Problems of quantification and measurement have restricted the possibilities of studying this variable. Among a coronary group of 100 young adults 91 per cent were found to be under occupational stress and strain as compared to 20 per cent found among a similar but unmatched control group.[128] The investigators who reported these findings stated also that "stress imposed by modern business competition has been found responsible for neurogenic disturbance of cholesterol metabolism and blood coagulability."

Income Levels: Any relationship between the level of income and heart disease occurrence is unestablished. The lack of information about income in death certificates limits the use of mortality data in clarifying this relationship. By comparing the 1953 death rates from

125 R. Buechley et al. *op. cit.*, pp. 1105-1111.
126 J. N. Morris et al. *op. cit.*, pp. 1053-1057 and 1111-1120.
127 J. M. Chapman et al. *op. cit.*, pp. 38-39.
128 H. L. Russek and B. L. Zohman, *op. cit.*

arteriosclerotic heart disease among policy-holders it was found that those who represent the lower socio-economic groups experienced significantly higher rates at ages under 65 than ordinary policy-holders who represent higher socio-economic groups.[129] Death rates of these two groups beyond the age of 65 years were reversed in pattern with lower rates among lower socio-economic groups. The age-adjusted rates of disability from cardiovascular-renal diseases among families on relief was found to be 2.7 times that among non-relief families with an income of $3,000 or more.[130] In the same study, rates among non-relief families were found to increase consistently with income levels from under $1,000 to $3,000 and over. In the study of chronic illness in Baltimore, income levels below $6,000 a year were found to be inversely correlated with prevalence rates of heart disease.[131] However, these rates tended to increase again at incomes of $6,000 and over. Such findings suggest a curvilinear relationship between the two variables.

There is a host of other socio-economic and socio-psychological factors whose relationship to heart disease needs to be explained. Factors such as social isolation, family conditions, role and normative conflicts, competition and stress for achievement have long been suspected by physicians as being related to the development of certain types of heart disease. As has been mentioned above, the complexity inherent in the methods of measurement of these variables hinders the efforts toward their investigation.

Psychological factors such as anxiety, sensitivity and emotional disturbance have been brought under study mostly by psychiatrists under clinical conditions.[132]

Findings related to habits have been reported by several investigators. The most frequently studied habit is that of smoking, which was found to be associated with heart disease in varying degrees.[133] This association is sometimes interpreted as being a correlation between smoking and emotional tension and stress, a condition that is described as being conducive to the development of certain types of heart disease.[134]

129 E. A. Lew, *op. cit.*, pp. 204-205.

130 S. D. Collins, "Illness from Heart Disease and Other Cardiovascular-Renal Diseases in General Morbidity Surveys of Families," Pub. Health Reports, 64, 46· 1439-1492, November, 1949, pp. 43-46.

131 Commission on Chronic Illness, *op. cit.*, p. 85.

132 For example see: D. C. Peete, *The Psychosomatic Genesis of Coronary Artery Disease.* C. E Thomas, Springfield, Ill. 1955; E. Weiss, "Cardiovascular Lesions of Probable Psychosomatic Origin in Arterial Hypertension" *Psychosomatic Medicine,* 2: 249-264; T. P. Wolfe, "Emotions and Organic Heart Disease", *Am. J. Psychiatry,* 93: 681-691.

133 For example see: T. R. Dawber et al. *op. cit*, 20-21; E. C. Hammond and D. Horn, "The Relationship Between Human Smoking Habits and Death Rates", *Jour. Am. Med. Assoc.,* 155: 1316; and H I. Russek and B. L. Zohman, *op. cit.*

134 H I. Russek and B. L. Zohman, *op. cit.*

Findings Related to Heart Disease as an Independent Variable

This part of the discussion is concerned with findings reported in studies of the consequences of heart disease. The most important of these studies are those investigating factors and conditions conducive to the adjustment of cardiac patients. The importance of such findings can be readily recognized in view of the long-time chronic nature of heart disease. Several psychoanalytic findings, related to the impact of heart disease onset upon the psychological conditions of patients, were reported.[135] Bellak and Haselkarn pointed out the following problems as being specific to cardiac illness: (a) that it is viewed as "severe threat to life" due to its association with sudden death, (b) that work as a rehabilitative process is frequently considered by patients as hazardous, (c) that the organ involved, i.e., the heart, is the symbol of basic human emotions, makes people attach more importance to it, and (d) iatrogenic problems resulting from the sensitivity and apprehensiveness of physicians about having a coronary disease, which in turn results in projecting their own anxieties on to their patients.[136]

Rehabilitative practices and work simplification constituted an important and active area of studies.[137] For fruitful application of the quantification and measurement of energy requirements for specific jobs, the therapeutic and functional capacities of patients should be also quantified and precisely measured.[138]

Perhaps the most important field study of adjustment to heart disease is that conducted among Indiana farmers by a team of researchers from Purdue University. This interdisciplinary study has dealt with various aspects of adjustment. An estimate of energy requirements for farm work was reported.[139] Such an estimate can be used in budgeting energy according to the functional capacity of the patient, and in avoiding the peaks of energy expenditure. Morris reports that the response of farm cardiacs to energy conservation ranged from expansion of business to retirement, with a consistent tendency among farmers with ASHD to lessen their work considerably more than normals in the same age groups.[140] The effect of other types of heart disease upon work was neither as marked nor as consistent.

135 For example see C L Bacon 'Psychoanalytic Observations on Cardiac Pain, *Psych Anal Quart* 23 7 19, L Bellack and F Haselkorn, Psychological Aspects of Cardiac Illness and Rehabilitation *Soc Casework* 37 483-489

136 L Bellak and F Haselkorn *op cit*

137 For example see B J Black, "Rehabilitation and Readjustment of the Cardiac Patient" *Conn St Med Jour* 20 3 196,F Haselkorn and L Bellak, ' A Multiple Service Approach to Cardiac Patients', *Soc Casework* July 1950, A Jezer and B J Black "Rehabilitation of the Older Cardiac Patient", Geriatrics 12 375-380, and *Proceedings of Purdue Cardiac Seminar* Papers No 3 9, Purdue Univ, Lafayette, Indiana

138 D R Sparkman, "Medical Implications for Practicing Physicians", Proceedings of the Purdue Farm Cardiac, *op cit*

139 W H M Morris, 'The Application of Energy Requirement Data in Estimating the Work Load of Farmers' Paper No 8, Purdue Farm Cardiac Seminar, Lafayette, Indiana, Sept 1958

140 W H M Morris, 'Work Load and Work Method of Normal and Impaired Farm Operators," Paper No 17, Purdue Farm Cardiac Seminar Lafayette, Indiana Sept 1958

Riedel distinguished among five aspects of adjustment, i.e., individual, medical, economic, social and psychological.[141] Findings related to the perceived therapeutic advice and the degree of compliance to it, indicate that the most frequent subject of advice is work with diet being second and recuperation third in frequency of mention.[142] Deviation from advice occurred more frequently in regard to work and personal habits such as smoking. Several reasons were advanced for non-compliance with therapeutic recommendations, such as habitual compulsiveness toward work, certain beliefs about the disease and economic reasons. Findings related to the role of family integration in the adjustment and rehabilitation of cardiac patients were also explored in the Purdue study. Dager reported significant differences between cardiacs in integrated families and others in non-integrated families in responses to an **a priori** family index that was selected from the data collected in the field study. These two groups differed in the frequency of occupying organizational offices, the number of close friends and participation in religious services, with cardiacs in integrated families exceeding those in non-integrated families in these three aspects of social participation. A more reasonable attitude toward disease and therapeutic institutions was found among cardiacs in integrated families, as compared to a tendency toward fatalism found among those in non-integrated families.[143]

Several rehabilitative programs and demonstrations for cardiacs were conducted during the last decade.[144] Reports about such experiences include valuable cues and hypotheses related to the problem of adjustment of cardiac patients. However, there is a definite need for systematic research work in this area.

Other Findings of Studies Related to Heart Disease

Discussion under this heading includes other important findings that were not found to fit under any of the previously discussed categories. One of the explored areas of studies is that related to the amount of knowledge possessed by the public about diseases of the heart. It is believed that the possession of a reasonable amount of authentic information about a disease will help the patient cooperate with his physician and achieve faster and better adjustments. Lack of knowledge frequently results either in failure to adhere to medical recommendations or undue neurotic anxiety and fear.[145]

141 D C Riedel, "Factors in Personal Adjustment to Heart Diseases", Unpublished M S Thesis, Purdue University, Lafayette, Indiana, 1957

142 R L Eichhorn, D C Riedel and W H M Morris, "Compliance to Perceived Therapeutic Advice" Paper No 16, Purdue Farm Cardiac Seminar, Lafayette, Indiana, Sept 1958

143 E Z Dager, "Family Integration and the Response to Heart Disease," Paper No 15, Purdue Farm Cardiac Seminar, Lafayette, Indiana, Sept 1958

144 For example see L E January, J P Stoikvic, T A Robb and W L Van Eschen, "Cardiac-in-Agriculture Demonstration", Iowa Heart Assoc, A Jezer et al "Workshop Experience with the Disabled Cardiac", *Brit J Physical Med*, Jan 1954 and E M Lawrence, "A Pilot Study of Vocational Counseling for Children with Heart Disease or a History of Rheumatic Fever Preliminary Report", The Am Heart Assoc and New York Heart Assoc, Dec 1956

145 L Bellak and F Haselkorn, *op cit*

In studying the level of information among clinic patients about 10 common diseases, respondents answered an average of only 55 per cent of the questions correctly.[146] It was also demonstrated that respondents were poorest in information about coronary thrombosis, with an average of 38 per cent of the questions being answered correctly. Other findings of the same study showed that the level of knowledge about diseases was significantly correlated with the level of education, and that those who had an experience with a disease were better informed about it. Findings from the Purdue study provide confirmatory evidence of a higher level of information about heart disease among previously diagnosed cardiacs.[147] Although physicians were found to favor more information among patients, they consistently tended to underestimate the patients' level of knowledge about diseases.[148] Physicians were found also to be less likely to discuss illness at length with patients whose knowledge they greatly underestimated.

A more specific study of lay knowledge about heart disease was done among residents of selected areas in Louisiana.[149] Over one-fourth of the sample did not know the importance of heart disease as a cause of death. A significant proportion of the respondents failed also to know about the meaning of heart failure, heart murmur and the electrocardiogram. Similar proportions did not realize that there were several kinds of heart disease and could not mention any of the heart disease symptoms. Such a low level of information among respondents was reflected in attitudes of fatalism toward the disease and ambivalence toward those who have it. A small proportion of the respondents expressed readiness to hire individuals with heart disease. Findings in this study demonstrate also a positive correlation between the level of knowledge about heart disease on the one hand and levels of education and income on the other. More knowledge about the disease was shown by urban than rural respondents, and by whites than Negroes. Other findings indicate that "talking with friends and neighbors" rated first among sources of information. Magazines and newspapers were rated second, except for rural-farm respondents who rated experience in the second place. The majority of respondents, however, considered the family doctor as the source where they would seek diagnosis or more information about the disease. Physicians rated highest also in choices among sources of information made by respondents in the Purdue study.[150] Investigators in the Louisiana study concluded that the cultural patterns and mentality of the population should be fully appreciated and accounted for in planning health educational programs.

146 A W Seligmann and N E McGrath, "Level of Medical Information Among Clinic Patients", *Jour Chr Dis*, 6, 5 497-509

147 D C Riedel, R L Eichhorn and W H M Morris, "Information and Beliefs Concerning Health and Heart Disease" Paper No 14, Purdue Farm Cardiac Seminar, Lafayette, Indiana, Sept 1958

148 L Pratt, A Seligmann and G Reader, "Physician's Views on the Level of Medical Information Among Patients", *Am Jour Pub Health*, 47, 10 1277-1283

149 A L Bertrand and C A Storla, Jr, *Lay Knowledge and Opinion about Heart Disease*, La Agr Exp Station, La State University, 1955

150 D C Riedel, R L Eichhorn and W H M Morris, *op cit*, p 22

APPENDIX I

THE INTERNATIONAL STATISTICAL CLASSIFICATION FOR IMPORTANT DISEASES OF THE HEART

Chronic Rheumatic Heart Disease (410-416)

410 Diseases of mitral valve*

Mitral (valve) (heart) (rheumatic)
- disease (fibroid) (double)
- endocarditis
- incompetency
- insufficiency

(inactive) (chronic)
- obstruction
- regurgitation
- sclerosis
- stenosis

No mention of rheumatic disease is necessary for inclusion in this title, it excludes the above conditions only when specified as of non-rheumatic origin (421.0).

411 Diseases of aortic valve specified as rheumatic*

Aortic (valve):
- insufficiency
- stenosis
- valvular disease

} specified as rheumatic

This title excludes diseases of aortic valve unless specified as rheumatic (421.0).

412 Diseases of tricuspid valve*

Tricuspid (valve) (heart) (rheumatic) (inactive) (chronic):
- disease
- insufficiency
- obstruction
- regurgitation
- stenosis

No mention of rheumatic disease is necessary for inclusion in this title; it excludes the above conditions only when specified as of non-rheumatic origin (421.2).

413 Diseases of pulmonary valve specified as rheumatic*

Pulmonary valve:
- disease
- insufficiency
- stenosis

} specified as rheumatic

This title excludes diseases of pulmonary valve unless specified as rheumatic (421.3).

414 Other endocarditis specified as rheumatic

Aneurysm of valve of heart, rheumatic

Degeneration of cardiac valve, rheumatic

Rheumatic:

* When more than one valve is mentioned priority in classification follows the order of listing in numbers 410-413

endocarditis (chronic)
valvulitis (chronic)
Valvular:
insufficiency } (chronic) (inactive) specified
stenosis } as rheumatic

This title excludes chronic endocarditis unless specified as rheumatic (421.4).

415 Other myocarditis specified as rheumatic
Rheumatic degeneration, myocardium
Rheumatic myocarditis (chronic)

416 Other heart diseases specified as rheumatic
Rheumatic (inactive) (chronic):
carditis, chronic heart disease
Adherent pericardium
Chronic: } NOS or
mediastinopericarditis } rheumatic
myopericarditis
pericarditis

Arteriosclerotic and Degenerative Heart Disease (420-422)

420 Arteriosclerotic heart disease, including coronary disease

420.0 Arteriosclerotic heart disease so described
Arteriosclerotic heart (disease)

420.1 Heart disease specified as involving coronary arteries
Aneurysm of heart
Cardiac infarction or thrombosis
Coronary (artery)
aneurysm
arteriosclerosis
arteritis
atheroma
disease
embolism
infraction
Coronary (artery):
occlusion
rupture
sclerosis
stricture
thrombosis
Embolism of heart,
Infarction of heart,
myocardium, or
ventricle
Rupture of coronary artery

This title includes any of the above conditions with any disease classifiable under 420.2, 422, 440-443.

420.2 Angina pectoris without mention of coronary disease
Angina:
NOS
pectoris } without mention of coronary disease, or any condition in 420.1
Cardiac angina
Vasomotor angina

This title includes any disease classifiable under 422 or 440-443 if angina pectoris is mentioned, and coronary disease (420.1) is not mentioned.

421 Chronic endocarditis not specified as rheumatic

This title excludes chronic endocarditis specified as syphilitic (023) or gonococcal (034).

421.0 Of mitral value, specified as non-rheumatic

Mitral (valve) (heart) (chronic):
- disease (fibroid) (double)
- endocarditis
- incompetency
- insufficiency
- obstruction
- regurgitation
- sclerosis
- stenosis

} specified as non-rheumatic

This title also includes the above conditions when reported with non-rheumatic tricuspid or other valvular disease.

421.1 Of aortic valve, not specified as rheumatic

Aortic (valve):
- atheroma
- disease, heart
- endocarditis, chronic or NOS
- insufficiency
- regurgitation
- stenosis

Aortic valvular sclerosis

} not specified as rheumatic and without mention of mitral disease.

This title excludes diseases of aortic valve specified as rheumatic (411).

421.2 Of tricuspid valve, specified as non-rheumatic

Tricuspid (valve) (heart) (chronic):
- disease
- insufficiency
- obstruction
- regurgitation
- stenosis

} specified as non-rheumatic and without mention of mitral or aortic valve disease

421.3 Of pulmonary valve, not specified as rheumatic

Pulmonary valve:
- insufficiency
- stenosis

} not specified as rheumatic and without mention of other valve

421.4 Other and ill-defined, not specified as rheumatic

- Aneurysm of valve of heart
- Atheroma of cardiac valve
- Degeneration of cardiac valve
- Endocarditis
- Endomyocarditis
- Endopericarditis
- Rupture of valve of heart
- Valvular:
  - disease
  - endocarditis
  - incompetence
  - obstruction
  - regurgitation
  - stenosis
- Valvulitis NOS

} (chronic) not specified as rheumatic

This title excludes endocarditis (chronic) specified as rheumatic (414).

422 Other myocardial degeneration

This title excludes the under-mentioned conditions with: hypertension (440-443); coronary disease (420.1); angina pectoris (420.2); and arteriosclerosis (422.1).

422.0 Fatty degeneration

Fatty degeneration:
- heart
- myocardium

Fatty:
- heart
- infiltration of heart
- myocarditis

422.1 With arteriosclerosis

Cardiosclerosis
Cardiovascular:
- degeneration
- disease
- sclerosis

Myocardial degeneration, with arteriosclerosis, or synonym in 450

422.2 Other

Atheroma
Atrophy
Calcification
Degeneration
- brown
- calcareous
- ischaemic
- mural
- muscular
- pigmentary

Glycogenic infiltration
Rupture

of heart or myocardium

Cardiac:
- insufficiency
- ossification

Heart disease:
- fibroid
- senile

Myocardial:
- degeneration
- disease
- insufficiency
- sclerosis

Myocarditis:
- NOS
- chronic (interstitial)
- senile

Myocardosis

Other Diseases of Heart (430-434)

430 Acute and subacute endocarditis

430.0 Acute and subacute bacterial endocarditis

Endocarditis:
- bacterial
- infective
- lenta
- malignant
- purulent
- septic
- ulcerative
- vegetative

Mycotic aneurysm

(acute) (chronic) (subacute), not specified as rheumatic

This title excludes acute endocarditis specified as rheumatic (401.1).

430.1 Other acute endocarditis

Aortic endocarditis
Endocarditis
Myo-endocarditis
Peri-endocarditis

acute or subacute, not specified as rheumatic

This title excludes acute endocarditis specified as rheumatic (401.1).

431 Acute myocarditis not specified as rheumatic

Acute or subacute (interstitial) myocarditis
Septic myocarditis
Toxic myocarditis

not specified as rheumatic

This title excludes acute myocarditis specified as rheumatic (401.2).

432 Acute pericarditis specified as nonrheumatic

Haemopericardium
Hydropericardium
Mediastinopericarditis
Myopericarditis
Pericarditis
Pleuropericarditis
Pneumopericarditis

acute, specified as nonrheumatic

Pericarditis:
- infective
- pneumococcal
- purulent
- suppurative

Pyopericardium

not specified as rheumatic

This title excludes rheumatic pericarditis (acute 401.0, chronic 416, unqualified 401.9), and pericarditis of unspecified cause (acute 401.0, chronic 416, unqualified 434.3).

433 Functional disease of heart

This title excludes functional heart diseases specified as psychogenic (315).

433.0 Heart block

Arborization block
Heart block (any degree)

Stokes-Adams syndrome

433.1 Other disorders of heart rhythm

Arrhythmia (transitory)
Auricular flutter
Bradycardia (any type)
Extrasystole

Fibrillation:
- auricular
- cardiac
- ventricular

Paroxysmal tachycardia
Pulsus alternans

433.2 Other functional diseases of heart

Disordered action of heart NOS

434 Other and unspecified diseases of heart

434.0 Kyphoscoliotic heart disease

Heart disease or cardiac failure, associated with any condition classifiable under 745.

434.1 Congestive heart failure

Cardiac:
- anasarca
- dropsy
- oedema

Congestive heart:
- disease
- failure

434.2 Left ventricular failure

Acute oedema of lung
Acute pulmonary oedema
Cardiac asthma
Left ventricular failure

} specified as due to heart disease or failure

434.3 Other and unspecified disease of heart

Adherent pericardium
Mediastinopericarditis, chronic
Myopericarditis, chronic
Pericarditis, chronic

} specified as non-rheumatic

Cardiac:
- decompensation
- dilatation (acute)
- hypertrophy

Constrictive pericarditis, NOS
Cor pulmonale

Carditis:
- NOS
- acute
- subacute

Morbus cordis NOS
Organic heart disease

Enlargement of heart
Haemopericardium NOS
"Heart disease" NOS
Hemopericardium NOS
Hydropericardium NOS

Pericarditis NOS
Ventricular dilation
Other disease of heart non-classifiable elsewhere

This title excludes heart disease specified as rheumatic acute (401, 402) chronic (410-416).

Hypertensive Disease (440-443)

440 Essential benign hypertension with heart disease

Hypertensive:
- cardiovascular disease
- heart (disease)

Myocardial degeneration, or any condition in 422, with hypertension
Any condition in 444 associated with conditions in 422 and 434

} If hypertension is described as benign

This title excludes above conditions if coronary disease is mentioned (420.1), and if angina pectoris is mentioned (420.2).

441 Essential malignant hypertension with heart disease

Any condition in 440 if hypertension is described as malignant.

This title excludes above conditions if coronary disease is mentioned (420.1), and if angina pectoris is mentioned (420.2).

442 Hypertensive heart disease with arteriolar nephrosclerosis

Arteriolar nephritis
Arteriosclerosis of kidney
Arteriosclerotic nephritis
Hypertension of kidney
Nephrosclerosis
Any condition in 594 with hypertension
} associated with conditions in 422 and 434

Cardiorenal (hypertensive):
arteriosclerosis
disease
sclerosis

Cardiovascular renal (hypertensive):
disease
sclerosis
Nephritis, cardiovascular

This title excludes above conditions if coronary disease is mentioned (420.1), and if angina pectoris is mentioned (420.2).

443 Other and unspecified hypertensive heart disease

Any condition in 440 if hypertension is not specified as to whether benign or malignant.

This title excludes above conditions if coronary disease is mentioned (420.1), and if angina pectoris is mentioned (420.2).

Appendix II

THE CODING SYSTEM OF THE NOMENCLATURE AND CRITERIA FOR DIAGNOSIS OF DISEASES OF THE HEART AND BLOOD VESSELS

ETIOLOGICAL DIAGNOSIS

	Code Numbers
1. Anemia	-540
2. Animal parasites	-2 . .
3. Arteriosclerosis	-942
4. Bacterial infection	-100
5. Congenital anomaly	-0 . .
6. Hypertension	-533
7. Hyperthyroidism	-771
8. Hypothyroidism	-772
9. Neoplasm	-8 . .
10. Neurocirculatory asthenia (effort syndrome)	-580
11. Other etiological factors (to be specified)	
12. Other infections	-1 . .
13. Pulmonary arterial hypertension	-535
14. Reflex disturbance of the heart	-582; -584; -589; -590
15. Rheumatic fever	-932
16. Syphilis	-147
17. Thiamin deficiency	-7621
18. Toxic agent	-3 . .
19. Trauma	-4 . .
20. Unknown	-x00—functional reaction alone manifest -900—structural reaction alone manifest

Diseases of Aorta and Pulmonary Arteries

	Code Numbers
1. Aneurysm of aorta (specify location)	46 . . - 6
2. Aneurysm of pulmonary artery	4711- 6
3. Aortitis	461-1 . .
4. Arteriosclerosis of aorta	461-942
5. Arteriosclerosis of pulmonary arteries	471-942
Congenital anomaly of aorta or pulmonary artery (see diagnosis 38)	
6. Dissecting hematoma of aorta (dissecting aneurysm)	46 . -911.7
(specify location)	46 . -941.6
7. Embolism of aorta	4616-496.4
8. Embolism of pulmonary arteries (acute or pulmonale)	471-496.4
9. Injury of aorta or pulmonary artery	461.4 . .
10. Other diseases of aorta (specify lesion)	4611-4 . .
11. Other diseases of pulmonary arteries (specify lesion)	471-
12. Rupture of aorta, spontaneous	46 . - 5
13. Thrombosis of aorta	46 . - 7
14. Thrombosis of pulmonary arteries	471- 7

Diseases of Coronary Arteries

15. Arteriosclerosis of coronary arteries	41x-942
16. Arteritis of coronary arteries	41x-100
Congenital anomaly of coronary artery (see diagnosis 38)	
17. Embolism of coronary artery	41x-496.4
18. Other diseases of coronary artery (specify)	41x
19. Periarteritis nodosa of coronary arteries	41x-931.0
20. Stenosis of coronary orifice	41x- 4
21. Thrombosis of coronary artery	41x- 7
22. Trauma of coronary artery (specify character of lesion)	41x-4 . .

Diseases of Endocardium and Valves

Congenital anomaly of endocardium or valves (see diagnosis 38)

	Code Numbers
23. Endocarditis, acute bacterial (specify organism)	450-1 . .
24. Endocarditis, indeterminate	450-941.4
25. Endocarditis, subacute bacterial (endocarditis lenta) (specify organism)	450-1 . .
26. Mural endocarditis	456-1 . .
27. Mural thrombosis	456-1 . . . 7 -511.7 -932.7
28. Neoplasm of endocardium	450-8 . .
29. Other structural diseases of endocardium or valves (specify location if possible)	450- 451-
30. Rupture of valve or of chordae tendineae (specify valve)	451-1 . . . 5 457-1 . . . 5
31. Traumatic injury or endocardium or valves (specify lesion)	451-4 . . 457-4 . .

32. Valvular deformity	
a. Aortic insufficiency	455- x
b. Aortic stenosis	455- 4
c. Mitral insufficiency	454- x
d. Mitral stenosis	454- 4
e. Tricuspid insufficiency	452- x
f. Tricuspid stenosis	452- 4
33. Valvular sclerosis (specify valve affected)	45.-941
34. Valvulitis, active (specify deformity, if any)	45 . - . . .
35. Valvulitis, inactive (specify deformity, if any)	45 . - 0

Diseases of Myocardium

(Including Conduction System and Heart as a Whole)

	Code Numbers
36. Aneurysm of heart (specify location)	41x-942.6
37. Atrophy of heart	410-701 -798 -911
38. Congenital anomaly of heart or great vessels (specify lesion if possible)	410-010
A. Non-Cyanotic Group	
A1. Aneurysm of sinus of Valsalva, Congenital	4612-015
A2. Aortic ring, double aortic arch	461-019
A3. Aortic stenosis	455-017
A4. Bicuspid aortic valve	455-0242
A5. Coarctation of aorta	
(1) Infantile type	461-018
(2) Adult type	461-0181
A6. Dextrocardia	410-021
A7. Dilatation of pulmonary artery, primary	4711-015
A8. Hypertrophy of heart, congenital	410-013
A9 Hypoplasia of aorta	461-016
A10. Left coronary artery arising from pulmonary artery	41x2-010
A11. Pulmonary veins all drain into right atrium	486-021
A12. Pulmonary veins entering right atrium or superior vena cava	486-022
A13. Pulmonic stenosis, isolated	4711-018
A14. Right aortic arch	
(1) Right aortic arch with aorta descending on right	4613-019
(2) Right aortic arch with left descending aorta	4613-0192
A15. Subaortic stenosis	436-019
A16. Tricuspid valves in anomalous position	452-021
B. Potentially Cyanotic Group (cyanose tardive)	
B1. Atrial septal defect	412-Oxx -030 -Ox9
B2. Combined atrial and ventricular septal defects (persistent atrioventricularis communis)	412-0x3
B3. Patent ductus arteriosus	40x-0x0
B4. Patent foramen ovale (persistent ostium secundum)	412-0x2
B5. Ventricular septal defect (maladie de Roger)	413-0x5
C. Cyanotic Group	
C1. Aortic atresia or stenosis	455-017
C2. Eisenmenger complex	413-0x3
C3. Persistent truncus arteriosus	4051-01x

C4. Single ventricle with rudimentary outlet chamber (cor triloculare biatriatum)	413-0x8
(1) When pulmonary artery arises from rudimentary chamber	
(2) When great vessels are transposed, aorta arising from rudimentary chamber, pulmonary artery from common chamber	
C5. Tetralogy of Fallot	413-0x0
C6. Transposition of great vessels, complete or partial	4051-02x -02x1
C7. Tricuspid stenosis or atresia (pseudo-triloculare)	452-018
39. Degeneration of myocardium (specify variety, if possible)	430-511 -516 -922 -955
40. Enlargement of heart (chambers involved may be specified)	
a. Dilatation	410-43x
b. Hypertrophy	410-43x.6
41. Fatty infiltration of heart	410-754
42. Fibrosis of myocardium	430-511.6 -516.6 -942.6 -955
43. Infarct of myocardium	430-511.7 -512.7 -515.7 -516.7
a. Atrial infarction	431-51..7
b. Ventricular infarction	434-51..7
44. Myocarditis, active	430-930 -932
45. Neoplasm of heart (specify type)	410-8..
46. No structural disease of heart	410-000
47. Other structural diseases of heart (specify lesion)	4..
48. Rupture of myocardium (specify location)	4...-1...5 -416 -5x7.5
49. Thrombosis within heart (specify chambers) (see also Mural thrombosis)	43.-522.7 -5x4
50. Trauma of myocardium	43x- 4..
51. Undiagnosed structural disease of heart (specify location, if possible)	4..-9Y0

Diseases of Pericardium

52. Calcification of pericardium	420-923
53. Congenital anomaly of pericardium (specify lesion)	420-0..
54. Hemopericardium	420-4...7
55. Hydropericardium	420-522.8 -900.8
56. Neoplasm of pericardium	420-8..
57. Other structural diseases of pericardium	
58. Pericarditis, acute	420-1..
a. Fibrinous	420-511.7 -932
b. Serofibrinous	420-1...8
c. Suppurative	420-1...2

59. Pericarditis, chronic	420-100.0
a. Adhesive without constriction	420-1x0.6
b. Constrictive	420-1x0.4
c. Serous	420-1x0.8
60. Pneumopericardium	420-1 . . . 3 -4 . . . 3
61. Trauma to pericardium (specify character of lesion)	420-4 . .

PHYSIOLOGICAL DIAGNOSIS

(Cardiac Mechanism)

	Code Numbers
1. Arrhythmia (undiagnosed)	451
2. Atrial Fibrillation	
a. Transient	425
b. Persistent	426
3. Atrial Flutter	
a. Transient	423
b. Persistent	424
4. Atrioventricular block	
a. Incomplete A-V block (prolonged conduction time)	434
b. Incomplete A-V block	435
c. Complete A-V block	436
5. Atrioventricular Nodal Rhythm	433
6. Escaped beats (ventricular escape)	443
7. Intraventricular block	437
8. Other arrhythmias (specify)	
9. Paroxysmal tachycardia	
a. Atrial	422
b. Atrioventricular nodal	432
c. Unknown supraventricular origin	460
d. Ventricular	442
10. Premature contractions	
a. Atrial	421
b. Atrioventricular	431
c. Unknown supraventricular origin	456
11. Pulsus alternans	441
12. Sinus arrest (sino atrial block)	454
13. Sinus arrhythmia	411
14. Sinus bradycardia	412
15. Sinus rhythm, normal	413
16. Sinus tachycardia	450
17. Ventricular fibrillation	414
18. Wandering pacemaker	445 415

Valvular Incompetence

19. Valvular Incompetence	408
a. Aortic incompetence	407
b. Mitral incompetence	406
c. Pulmonic incompetence	405
d. Tricuspid incompetence	
20. Adams-Stokes Syndrome	455
21. Anginal Syndrome	401
22. Cardiac insufficiency	404
23. Carotid Sinus Syndrome	9684-584.x

FUNCTIONAL CAPACITY

Class I	Patients with cardiac disease but without resulting limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea or anginal pain.	457
Class II	Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinarily physical activity results in fatigue, palpitation, dyspnea or anginal pain.	458
Class III	Patients with cardiac disease resulting in marked limitation of physical activity. They are comfortable at rest. Less than ordinary activity causes fatigue, palpitation, dyspnea or anginal pain.	459
Class IV	Patients with cardiac disease resulting in inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency or of the anginal syndrome are present even at rest. If any physical activity is undertaken, discomfort is increased.	45x

THERAPEUTIC CLASSIFICATION

Class A	Patients with a cardiac disease whose ordinary physical activity need not be restricted.
Class B	Patients with cardiac disease whose ordinary physical activity need not be restricted, but who should be advised against severe or competitive physical efforts.
Class C	Patients with cardiac disease whose ordinary physical activity should be moderately restricted, and whose more strenuous efforts should be discontinued.
Class D	Patients with cardiac disease whose ordinary physical activity should be markedly restricted.
Class E	Patients with cardiac disease who should be at complete rest, confined to bed or chair.

NO HEART DISEASE 410-

PREDISPOSING ETIOLOGICAL FACTOR

UNDIAGNOSED MANIFESTATION 410-Y00

Appendix III

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